SEPTEMBER 24, 2004

WORKPLAN FOR ADDITIONAL MONITOR WELLS FOR MODEL REFINEMENT DSGWRD 26 – 020 AND WELL ABANDONMENT PLAN-MONITOR WELL G-19 DSGWRD 26 – 045

MONTROSE SITE

TORRANCE, CALIFORNIA

PREPARED FOR:
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

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25th Anniversary 2004

September 24, 2004

VIA FEDERAL EXPRESS

Mr. Jeffrey Dhont
Superfund Project Manager
U.S. ENVIRONMENTAL PROTECTION AGENCY
75 Hawthorn Street (SFD-7-1)
San Francisco, CA 94105-3901

Re: Submittal of Final Workplan for Additional Wells for Model Refinement (DSGWRD26-020), And Well Abandonment Plan-Monitor Well G-19 (DSGWRD26-045)
Montrose Site, Torrance, California

Dear Mr. Dhont:

Enclosed are the replacement pages for the document titled:

Final
Workplan for Additional Wells for Model Refinement
DSGWRD 26-**020**
And
Well Abandonment Plan-Monitor Well G-19
DSGWRD 26-**045**
Montrose Site
Torrance, California

Transmitted is the report cover, text, Tables 3 and 4, and Figures 15 and 21 of the Workplan. Please replace the relevant pages of the draft document dated August 5, 2004, with these replacement pages.

This report is being submitted to the U. S. Environmental Protection Agency (EPA) in accordance with the statement of work for the Unilateral Administrative Order for Initial Groundwater Remedial Design Activities.

This document has been prepared to incorporate responses to EPA comments received in correspondence dated August 16, 2004 (Attachment 1).

If you have any questions or comments, please contact me.

Sincerely,

HARGIS + ASSOCIATES, INC.

Michael A. Palmer, RG 5915, CHG 146
Principal Hydrogeologist

MAP/kal

Enclosure

Other Offices:
Mesa, AZ
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Dallas, TX

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cc: Mr. Jeffrey Dhont, U.S. Environmental Protection Agency (3 copies)
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Luke Mette, Esq., Stauffer Management Company, LLC (1 copy)
Mr. Lee Erickson, Stauffer Management Company, LLC (1 copy)
Paul Galvani, Esq., Ropes & Gray (without enclosure)

ATTACHMENT 1

**RESPONSE TO EPA COMMENTS ON
DRAFT WORK PLAN FOR ADDITIONAL MONITOR WELLS
FOR MODELING REFINEMENT
DSGWRD 26-20
MONTROSE CHEMICAL SUPERFUND SITE
LOS ANGELES, CALIFORNIA
DATED AUGUST 16, 2004**

Comments received August 16, 2004, in a letter from Mr. Jeffrey Dhont, U.S. Environmental Protection Agency, to Mr. Joe Kelly, Montrose Chemical Corporation

Comments on the Work Plan for Additional Monitor Wells for Modeling Refinement

1. FSP and Quality Assurance Project Plan. See Comment No. 1 with respect to the pCBSA Plan.

RESPONSE: The chlorobenzene-related objectives have been added to the FSP and QAPP that accompany the pCBSA workplan. In addition, the pCBSA Workplan has been updated to indicate that the FSP and QAPP are being used for the purposes of the Refinement Plan as well.

2. Page 6, top, states:

"When viewed together, available data from the Montrose and Del Amo Sites provide good lateral and vertical definition of the extent of chlorobenzene in the areas upgradient and downgradient of the Montrose Property. Similarly, acceptable definition of the extent of pCBSA is also available from the existing data, except in limited areas of the Bellflower Sand and the Gage Aquifers."

The next paragraph then goes on to discuss the need for an additional well due to the modeling (i.e. to evaluate the potential for leakage from the Bellflower Sand into the Gage in the area near BF-21).

This wording implies that the only chlorobenzene objective is the one raised by the modeling. However, another of the objective of the Refinement Plan is to characterize the downgradient extent of chlorobenzene in the Gage Aquifer at the toe of the plume. (We note that the G-19 issue existed at the time of the RI, although concentrations in it were much lower - 2600 ppb) Also, the term "acceptable" in the quoted segment above is rather vague as acceptable will always be relative to the objectives chosen. We suggest replacing the first paragraph above as follows:

"When viewed together, available data from the Montrose and Del Amo Sites generally provide good lateral and vertical definition of the extent of chlorobenzene in relation to the MCL, with the exception of the area downgradient of well G-19 in the Gage Aquifer. Because the concentration of chlorobenzene in well G-19 increased from 2,600 in 1995 to 12,000 in 2004, the extent of chlorobenzene downgradient of this well needs to be delineated. Similarly, available data provide reasonably good definition of the extent of pCBSA in relation to the 100 ppb contour (see later discussion regarding selection of this

value). However, there are limited areas at the upgradient and downgradient ends of the pCBSA plume in both the Bellflower Sand and the Gage Aquifers that remain undefined."

Then, please add a paragraph after the second paragraph which explains that wells will be added to close the contours in the Gage Aquifer near the toe of the plume.

RESPONSE: The first paragraph of page 6 has been replaced with the wording suggested in the review comment, as follows:

> The available data from both the Montrose and Del Amo Sites generally provide good lateral and vertical definition of the extent of chlorobenzene in relation to the maximum contaminant level, with the exception of the area downgradient of Gage aquifer monitor well G-19. Because the concentration of chlorobenzene in monitor well G-19 increased from 2,600 ug/l in 1995 to 12,000 ug/l in 2004, the extent of chlorobenzene downgradient of this well needs to be further delineated. Similarly, available data provide reasonably good definition of the extent of pCBSA in relation to the 100 ug/l contour. There are, however, limited areas at the upgradient and downgradient portions of the pCBSA plume in both the Bellflower sand and the Gage aquifer that remain undefined.

In response to EPA comments, an additional paragraph has also been added to Page 6, which explains that wells will be added by other investigative programs that will also serve to close the contours in the Gage Aquifer near the toe of the plume.

3. Section 4.1.1 and/or the FSP should present the rationale for the monitoring well construction details (See Comment 3 on the pCBSA Plan regarding the FSP). The Refinement Plan should also discuss whether an exploratory boring will be drilled at the location of well G-24 or whether the existing boring(s) will be used to determine the depth for the conductor casing and screened interval for this well.

RESPONSE: Lithologic data from the monitor well boring will be used to finalize the design of monitor well G-24. Existing information from exploratory boring EB-15 located to the north was used to design monitor well G-24. While existing information from exploratory boring EB-15 located to the north of G-24 was used to design monitor well G-24 for the purpose of the workplan, the actual well design will depend on lithologic data generated from the monitor well boring. To provide the reader with a reference to the available geologic data, the location of boring EB-15 has been added to Figure 15, and the geologic log for boring EB-15 has been added to the workplan as Table 3.

The rationale for monitor well construction details, including well depths, screened intervals and well construction materials, is based on previously drilled borings, previous monitor well construction, and the anticipated unit thickness and contact elevations. The screen interval will be selected so that the screen begins about five feet below the top of the Gage aquifer to ensure that compounds that may be migrating through the overlying aquitard are detected. The filter pack will extend several feet above the top of the screen but will not extend into the overlying aquitard sediments to ensure that an annular seal can be placed opposite the overlying aquitard sediments. The screen length will be selected to screen the majority of

the uppermost continuous coarse-grained interval of the Gage aquifer. The screen length will generally be at least 20 feet but could extend 40 or more feet depending on the thickness of coarse-grained sediments encountered. It is the intent that the groundwater sample obtained from Gage monitor well G-24 be representative of the interval that may be pumped during the groundwater remedy. The workplan has been updated to provide this rationale.

4. Section 4.2, beginning on page 14, describes a two-phase field program designed to evaluate whether well G-19 may have a failing well screen which is allowing contaminants to leak from the Bellflower Sand into the Gage Aquifer. The first phase involves comparing geochemical signatures of the water in the Bellflower Sand and Gage Aquifers. The second phase involves a sequential low-flow purging and sampling from distinct 10 foot zones within the screened interval of the well. The second and third paragraphs on page 16 indicate that if the phase 2 result reveals that samples from the upper portion of the screened interval have higher concentrations compared to the lower portion of the interval, then the well will be destroyed.

Comments and recommendations regarding this approach are summarized below.

- *The Refinement Plan should state that the potential vertical seepage in well G-19 will be assessed to determine (1) if the continuous Gage Aquifer plume is present at the location of this well, or the area of high concentrations is localized in the immediate vicinity of the well due to leakage through the well casing, and (2) if the well needs to be destroyed. Montrose should consider whether, before it is abandoned (assuming it is), additional information critical to the modeling effort can be obtained from G-19 so that the need to install another well at the same location may be avoided. Montrose should develop a description of the logic process (a definitive logic diagram is not needed, but the approach should be clear), various tools available to assess the well and meet the objectives, what the indications from each type of evaluation of the well might be, etc.*

- *The Refinement Plan does not mention the results from Phase 1, geochemical signatures, at all. The plan should indicate how the results from Phase 1 will affect the decisions needed to meet the objectives.*

- *It is certainly possible that, even without leakage through the well, concentrations could be higher in the upper part of the aquifer as compared to the lower part, especially when compared on 10-foot increments. Please discuss this in relation to how the information from this phase will be used and uncertainties associated with it, discussion of the (presumably) low cost associated with this approach, and the degree of usefulness associated with the various possible outcomes of this test.*

- *It should be explained in the Refinement Plan that if the highest concentrations are encountered in the middle or lower portion of the screened formation, it will likely indicate that chlorobenzene migrated to the well from the upgradient location. On the other hand, the results of this testing may not be conclusive, if high chlorobenzene concentrations are encountered in the upper portion of the screen, or if concentrations are uniform throughout the screened interval.*

- *The Refinement Plan should state that if the results of Phases I and II are not conclusive, other options will be considered during Phase III and discussed with EPA. For example, another*

option for evaluating the well would be to pump it fairly strongly, and see if concentrations reach a point where they suddenly drop. If the Gage Aquifer is truly contaminated at the levels indicated by the concentration in the well, then the levels should not change much after the purge volume is removed. If the well is leaking, then the contaminant concentrations in effluent groundwater will likely drop significantly in the coarse of pumping because the lateral extent of the high-concentration plume is expected to be limited to the proximity of the well. Water levels should be also monitored during pumping in the MBFC Sand well BF-24 to assess the hydraulic connection between the MBFC Sand and Gage aquifers at this location. This option would, of course, imply incurring costs for disposal of the water. The potential for the pumping to be performed after the treatment system for the pilot test is in place near the Armco site should be explored.

RESPONSE: Due to the uncertainties involved, Montrose has decided to not perform the evaluation of monitor well G-19, and has instead elected to replace the well with a new monitor well designated G-19A, which will be located directly upgradient from monitor well G-19. The text of the workplan has been revised to reflect this proposed action. The proposed design of monitor well G-19A has been added to Table 4. The proposed location of monitor well G-19A has been added to Figure 15.

If the results from monitor well G-19A indicate that the water quality data obtained from monitor well G-19 are not representative of the Gage aquifer in this vicinity, then monitor well G-19 will be properly destroyed in accordance with the procedures outlined in the Workplan.

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25th Anniversary 2004

August 5, 2004

VIA FEDERAL EXPRESS

Mr. Jeffrey Dhont
Superfund Project Manager
U.S. ENVIRONMENTAL PROTECTION AGENCY
75 Hawthorn Street (SFD-7-1)
San Francisco, CA 94105-3901

Re: Submittal of Draft Workplan for Additional Monitoring Wells for Model Refinement, Montrose Site, Torrance, California

Dear Mr. Dhont:

Enclosed are three copies of the report titled:

Workplan for Additional Monitoring Wells
For Model Refinement
Montrose Site
Torrance, California
DSGWRD 26-**020**

This report is being submitted to the U. S. Environmental Protection Agency in accordance with the statement of work for the Unilateral Administrative Order for Initial Groundwater Remedial Design Activities.

If you have any questions or comments, please contact me.

Sincerely,

HARGIS + ASSOCIATES, INC.

Michael A. Palmer, RG 5915, CHG 146
Principal Hydrogeologist

MAP/ama

Enclosure

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WORKPLAN FOR ADDITIONAL MONITOR WELLS FOR MODEL REFINEMENT DSGWRD 26 – **020** AND WELL ABANDONMENT PLAN-MONITOR WELL G-19 DSGWRD 26 – **045** MONTROSE SITE TORRANCE, CALIFORNIA

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ACRONYMS AND ABBREVIATIONS

BHC	Hexachlorocyclohexane
bls	below land surface
DDT	Dichlorodiphenyltrichloroethane
DWR	State of California Department of Water Resources
EPA	U.S. Environmental Projection Agency
FSP	Field Sampling Plan
H+A	Hargis + Associates, Inc.
LBF	Lower Bellflower aquitard
MBFC sand	Middle Bellflower C sand
Montrose	Montrose Chemical Corporation of California
pCBSA	para-Chlorobenzene sulfonic acid
pCBSA Workplan	Workplan for Para-Chlorobenzene Sulfonic Acid Data Acquisition
Property	Area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles, near Torrance, California
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
RD	Remedial design
ROD	Record of Decision
Site	Montrose Site
SOPs	Standard operating procedures
SOW	Statement of Work
UAO	Unilateral Administrative Order
ug/l	Micrograms per liter

ACRONYMS AND ABBREVIATIONS (continued)

VOCs	Volatile organic compounds
Workplan	Workplan for Additional Monitoring Wells for Model Refinement

WORKPLAN FOR ADDITIONAL MONITOR WELLS FOR MODEL REFINEMENT DSGWRD 26 – **020** AND WELL ABANDONMENT PLAN-MONITOR WELL G-19 DSGWRD 26 – **045** MONTROSE SITE TORRANCE, CALIFORNIA

1.0 INTRODUCTION

This Workplan for Additional Monitor Wells for Model Refinement (Workplan) has been prepared for Montrose Chemical Corporation of California (Montrose) in accordance with the requirements outlined in Section 5.6 of the Unilateral Administrative Order (UAO) Statement of Work (SOW), First Amendment (U.S. Environmental Protection Agency [EPA], 2004a). EPA's modeling program has identified three uncertainties in the hydrogeological conditions within the area to be influenced by the Torrance program's groundwater remedy, which may impact meeting the Record of Decision (ROD) requirements. Therefore, these uncertainties need to be resolved prior to continuing with the remedial design (RD) (EPA, 1999 and 2004a).

To resolve these uncertainties, this Workplan summarizes existing data regarding the extent of chlorobenzene at the Montrose Site (Site) and provides recommendations for the collection of additional data to: 1) evaluate the potential for chlorobenzene to migrate downward through the lower Bellflower aquitard into the Gage aquifer; 2) provide additional data to define the extent of chlorobenzene and para-chlorobenzene sulfonic acid (pCBSA) in the Gage aquifer at the toe of the plume, and 3) provide additional data regarding the groundwater flow and hydraulic gradient in the Gage aquifer. As a separate but related issue, this Workplan also addresses monitor well G-19 pursuant to a request by EPA in an email from Jeff Dhont dated July 1, 2004 (Figure 2) (EPA, 2004c).

To simplify this Workplan and to take advantage of investigation procedures developed for previous workplans for similar work that have already been reviewed and approved by EPA, this Workplan incorporates by reference many procedures described in detail in the Workplan for Para-Chlorobenzene Sulfonic Acid Data Acquisition (pCBSA Workplan), the associated pCBSA field sampling plan (FSP) and the associated pCBSA quality assurance project plan (QAPP), dated September 1, 2004 (Hargis + Associates, Inc [H+A], 2004c). Specifically, the FSP describes the objectives, rationale, methods, and procedures for monitor well construction and sampling and the QAPP describes the data quality objectives and quality assurance/quality control (QA/QC) procedures to be implemented during field and laboratory activities. Also, due to the comprehensive and extensive nature of supporting documentation that forms the background framework of this Workplan, information contained in the Montrose Remedial Investigation Report and the Baseline Groundwater Sampling Results Report is frequently incorporated by reference in this Workplan and has not been duplicated herein (EPA, 1998; H+A, 2004b).

1.1 PURPOSE

The purpose of this Workplan is to identify the additional data needed to resolve the hydrogeological uncertainties identified by EPA's modeling effort that could potentially negatively impact the groundwater remedy's success. These uncertainties include the following:

1. The potential for leakage of chlorobenzene and pCBSA from the Middle-Bellflower-C sand (MBFC sand) into the Gage aquifer east of Normandie Ave.
2. Delineation of the downgradient extent of the chlorobenzene and pCBSA plumes.
3. Assessment of the hydraulic gradient in the Gage aquifer.

Additionally, although not specifically identified by the modeling effort, uncertainties exist about the sampling data being generated by monitor well G-19. These uncertainties are related to the

delineation of the downgradient extent of chlorobenzene and possibly pCBSA, as listed above. The baseline sampling conducted during January and February 2004 indicated that chlorobenzene concentrations had increased significantly in that well over previous sampling events. As discussed in Section 3, this increase in concentration does not appear consistent with other sampling and hydrogeological data in the vicinity of monitor well G-19. This inconsistency may be due to samples from this well not being representative of the Gage aquifer, or, the hydrogeology in the vicinity of this well may be different than previously thought. Montrose has elected to install a replacement monitor well, G-19A, and may also destroy monitor well G-19 depending on the results obtained from monitor well G-19A. This Workplan provides field procedures for installing replacement monitor well G-19A, as well as procedures for destroying monitor well G-19, if necessary. The monitor wells for this and other UAO programs will assist in resolving the hydrogeological issues.

1.2 DEFINITION OF TERMS

To facilitate the discussion within this document, several defined terms are used as described below. For clarity of discussion only, this report will refer to the "Property" as the area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles, near Torrance, California (Figure 1). The term "central process area" or CPA refers to an approximate two-acre portion of the Property where most of the manufacturing operations were performed historically.

The term dichlorodiphenyltrichloroethane (DDT) or total DDT, will be used to refer to the sum of the isomers and metabolites of DDT. The term hexachlorocyclohexane (BHC) or total BHC, will be used to refer to the sum of the isomers of BHC.

1.3 OBJECTIVES AND SCOPE

In accordance with the UAO SOW Section 5.6.1, the objectives of this Workplan include:

- A description of the modeling refinement objectives to be accomplished by additional wells.
- The identification and rationale for the number and locations of monitor wells to be installed to meet the objectives.
- Identification of the property owners at the locations of the proposed wells and any anticipated issues with short- and long-term property access.
- A schedule of completion that lists the major tasks associated with this well installation, along with the start and end dates of each task.
- A complete description, including diagrams, of proposed well construction details and specifications; drilling method and all drilling equipment; all pertinent construction materials; measurements of borehole, casing, and annular space; depths of screened and blank casing; proposed pumps, transducers, and any other dedicated or temporary downhole equipment; methods to be used to determine depths and elevations; wellhead and well vault construction detail and specifications; and any other related details. Construction diagrams shall be provided relative to the stratigraphy encountered.
- A complete description of proposed well development procedures.
- A complete description of treatment and/or disposal of development water, drilling muds, and any other potentially contaminated media.
- The groundwater sampling procedures and chemical and physical parameters to be included in the sample analyses of the new wells, pending incorporation into the overall monitoring plan.

The first four bullets are addressed in this Workplan. The last four bullets are addressed in the pCBSA FSP and QAPP (H+A, 2004c) which are incorporated by reference.

Additionally, in regard to resolving uncertainties about the effectiveness of monitor well G-19, the following objective is to be accomplished.

- Identify procedures for installing a replacement monitor well, G-19A, immediately upgradient from monitor well G-19. If the results from monitor well G-19A indicate that the water quality results from G-19 are not representative of the Gage aquifer, then monitor well G-19 will be destroyed.

2.0 BACKGROUND

Background information including Site location and description, Site history, stratigraphy, hydrogeology, and previous investigations is summarized in the pCBSA Workplan (H+A, 2004c). Additionally, extensive information on the water levels and contaminant extent is provided in the baseline sampling report (H+A, 2004b). However, as an aid to the reader, recent water level figures and pCBSA and chlorobenzene concentration figures for the upper Bellflower aquitard, Bellflower sand, Gage aquifer, and Lynwood aquifer from the baseline sampling report are provided (Figures 3 through 14).

3.0 DATA GAP ANALYSIS AND PROPOSED WORK

The available data from both the Montrose and Del Amo Sites generally provide good lateral and vertical definition of the extent of chlorobenzene in relation to the maximum contaminant level, with the exception of the area downgradient of Gage aquifer monitor well G-19. Because the concentration of chlorobenzene in monitor well G-19 increased from 2,600 micrograms per liter (ug/l) in 1995 to 12,000 ug/l in 2004, the extent of chlorobenzene downgradient of this well needs to be further delineated. Similarly, available data provide reasonably good definition of the extent of pCBSA in relation to the 100 ug/l contour. There are, however, limited areas at the upgradient and downgradient portions of the pCBSA plume in both the Bellflower sand and the Gage aquifer that remain undefined.

An objective of the Model Refinement Plan is to characterize the downgradient extent of chlorobenzene in the Gage aquifer at the toe of the plume. Monitor wells G-18 and G-19 are currently the furthest downgradient monitor wells completed in the Gage aquifer. Monitor wells G-22 and G-23, which were proposed in conjunction with the pCBSA data acquisition program, are expected to provide the needed downgradient definition of the chlorobenzene plume.

In addition to the wells needed for downgradient definition of chlorobenzene in the Gage aquifer, modeling conducted by EPA indicates there remains an area west of the currently defined chlorobenzene plume where an additional Gage monitor well is needed. Based on the modeling results, chlorobenzene may be migrating downward from the Bellflower sand through the lower Bellflower aquitard into the Gage aquifer in this area. Monitor well G-24 will be installed west of Normandie Avenue to evaluate this potential data gap.

The modeling evaluation leading to this conclusion is described in the following section.

3.1 PRELIMINARY MODEL RESULTS

Model calibration using the automatic calibration software package titled "PEST" indicated that leakage could potentially occur in the western portion of the Site from the high-concentration area of the MBFC sand into the Gage aquifer through higher-conductivity zones in the lower Bellflower aquitard (LBF) which separates the MBFC sand and the Gage aquifer (EPA, 2004b). Because this leakage could potentially exist cross-gradient and downgradient of Gage aquifer monitor wells G-15 and G-16, these wells would not provide sufficient coverage to detect if concentrations of chlorobenzene and pCBSA were changing in the western and southwestern portion of the Gage aquifer (Figures 9 and 13).

However, based on available groundwater sampling data, such leakage from the MBFC sand into the Gage aquifer does not appear to be occurring. This area of the Gage aquifer has historically been presumed to be free of chlorobenzene (Figure 9). Consistent with the corresponding groundwater flow directions in these units, the known chlorobenzene and pCBSA distributions in the MBFC sand extend more to the southeast in comparison to the distributions of these constituents in the Gage aquifer, which extend more to the east (Figures 4, 5, 8, 9, 12, and 13). The chlorobenzene and pCBSA distributions in the MBFC sand also widen to the west, i.e., cross-gradient in the area of monitor well BF-20, BF-21, BF-29, and BF-31, which historically have had elevated concentrations of these constituents (Figure 8 and 12).

Conversely, two Gage aquifer wells located beneath this western portion of the chlorobenzene and pCBSA plumes in the MBFC sand, G-15 and G-16, have historically had very low or non-detectable concentrations of these contaminants and, therefore, these wells have been used to delineate the western edge of the chlorobenzene and pCBSA plumes in the Gage aquifer (Figure 9 and 13). From this data, it appears very unlikely that leakage of chlorobenzene and pCBSA from the western portion of the MBFC sand through the LBF into the Gage aquifer is occurring.

EPA readily acknowledges that this leakage into the Gage aquifer may not actually exist (EPA, 2004b). However, PEST calibration reveals that the potential for this leakage exists given the current data. As there are no monitor wells in the Gage aquifer to the west and southwest of

monitor wells G-15 and G-16, there is no way with existing data to refute this possibility (Figure 2). EPA indicated in their June 8, 2004, letter that "This uncertainty is problematic because, in the case of leaky LBF beneath the high concentration western area of chlorobenzene in the MBFC sand, it is almost assured that the Joint Groundwater Feasibility Study wellfield would fail to meet ROD objectives and could even make the contamination worse" (EPA, 2004c).

In short, this is an uncertainty, that if true, could potentially cause remedy failure, and EPA believes this uncertainty must be addressed for a successful RD (EPA, 2004b). To address this issue, one monitor well, G-24, is proposed in the Gage aquifer to fill this data gap (Figure 15). Details regarding the construction and sampling of this well are provided in Section 4.1.

3.2 MONTOR WELL G-19

As discussed in the introduction to this Workplan, recent chemical concentration data from Gage aquifer monitor well G-19 is inconsistent with other data in that portion of the Gage plume. The data inconsistency is of particular concern because monitor well G-19 lies at the toe of the plume where groundwater capture is critical to the success of the groundwater remedy. The following sections describe the well construction details for monitor well G-19 and provide an overview of the chlorobenzene and pCBSA concentrations in this well to provide the necessary context to discuss the inconsistency of data and possible explanations for this inconsistency.

3.2.1 Well Construction Details

Monitor well G-19 was constructed in 1991 and is currently the Gage aquifer monitor well located furthest downgradient from the Montrose Site (Figure 2). Well construction details and lithology based on core and drill cuttings are shown in Figures 19 and 20. Initially, an 8-5/8 inch conductor casing was grouted in place to 140 feet below land surface (bls) by pumping neat cement down a tremie pipe set into a stab-in cement shoe. The conductor casing borehole was

terminated at a depth of 141 feet bls or about three feet into the fine-grained sediments to minimize the risk of drilling through the aquitard and into the Gage aquifer. A 7-5/8-inch borehole was then advanced through the conductor casing and under-reamed to a 10-inch diameter to a total depth of 186.5 feet bls. Four-inch diameter stainless steel wire-wrap well screen was installed from about 144 to 184 feet bls. The annulus was then filter-packed with Lonestar 1-C sand and an inter-casing annular seal consisting of a combination of bentonite pellets and bentonite grout was installed to land surface (Figures 19 and 20).

The Bellflower sand was encountered from about 110 to 139 feet bls consisting of fine to medium sand (Figure 19). Finer-grained sediments, consisting predominantly of sandy silt interbedded with silty sand were encountered from about 139 to 153.5 feet bls. The coarsest portion of the Gage aquifer was encountered from 153.5 to 170 feet bls. The lithology of the Gage aquifer in this interval consists of fine to medium sand with some sandy silt interbeds.

3.2.2 Monitor Well G-19 Gage Aquifer Chlorobenzene and pCBSA Concentrations

Chlorobenzene was not detected in monitor well G-19, with a detection limit of 1 ug/l, in the initial groundwater sample collected shortly after the well was installed in July 1991 (Figure 16). However, chlorobenzene was detected at a concentration of 23 ug/l in the second groundwater sample collected about three months later. Since that time, the concentration of chlorobenzene has increased steadily to 12,000 ug/l in 2004 (Table 1; Figure 16). The concentration time-series pattern for pCBSA in monitor well G-19 is similar. The initial concentration of pCBSA in monitor well G-19 was 210 ug/l in a sample collected in October 1991 (Figure 17). In November 1995, the concentration of pCBSA in this well had increased to 24,000 ug/l. In 2004, the concentration of pCBSA in this well has increased to 53,000 ug/l (Table 2).

3.2.3 Well Performance Evaluation

The current elevated chlorobenzene and pCBSA concentrations in groundwater collected from monitor well G-19 appear anomalous because they are greater than those detected in the nearest upgradient Gage aquifer monitor wells, and, given the current understanding of groundwater flow direction in this portion of the Site, monitor well G-19 is not located directly downgradient from the center of mass in the Gage aquifer plume (Figure 9 and 13). There are various scenarios that may account for the relatively high and apparently increasing concentration of contaminants found in monitor well G-19. The three most likely are:

- Seepage from the MBFC sand.
  The construction of monitor well G-19 may allow groundwater containing chlorobenzene and pCBSA from the overlying MBFC sand to migrate downward along the well casing and seal into the Gage aquifer thereby increasing the concentrations in the immediate vicinity of the well compared to the surrounding area, i.e., samples withdrawn from this well would reflect the concentration of the groundwater seeping from the Bellflower sand into the Gage aquifer rather than the native conditions in the Gage aquifer.

- Different groundwater flow direction.
  As suggested by a preliminary evaluation of the regional groundwater flow direction conducted by EPA that used wells in addition to the Montrose monitor wells, the groundwater flow direction in the Gage aquifer from the Montrose property may actually be more southerly toward monitor well G-19 than originally thought.

- Coincident arrival of chlorobenzene and pCBSA plumes.
  The initial lack of detection of chlorobenzene in monitor well G-19 followed by continual increases in concentration could be due to a coincidental arrival of the chlorobenzene and pCBSA plumes at this location.

Of these three scenarios, the last is the least likely because the rapid increase to elevated concentrations would imply a relatively high groundwater velocity that is not generally consistent with the observed slow plume growth that has clearly been occurring over decades.

As to the seepage scenario, the chlorobenzene and pCBSA concentrations in monitor well G-19 are now on the same order of magnitude as present in the overlying Bellflower sand (Figures 8, 9, 12 and 13). Based on the water level data collected from monitor well G-19 and nearby Bellflower sand monitor well BF-24, it is apparent that the static water level in the Bellflower sand has consistently been 1 to 1.6 feet higher than that in the Gage aquifer. This indicates that there is hydraulic separation between these two units (Figure 18). However, there is only about three feet of aquitard material separating the Bellflower sand from the filter pack of monitor well G-19. Therefore, it is possible that groundwater may be moving downward either along the grout seal or through the upper portion of the aquitard sediments underlying the Bellflower sand in response to the static water level difference. Such a groundwater migration could result in elevated chlorobenzene and pCBSA concentrations in samples collected from monitor well G-19.

As to the differing groundwater direction scenario, there are presently no monitor wells downgradient of monitor well G-19 from which to obtain concentration and water level data to better delineate the chlorobenzene plume to the south. Two monitor wells, G-22 and G-23, located as shown on Figure 15, are planned for installation in this area as part of the pCBSA Workplan. These wells will provide further water level information downgradient of monitor well G-19 to resolve whether or not groundwater directions might be responsible for the elevated concentrations found in monitor well G-19.

Because monitor well G-19 is at the toe of the chlorobenzene plume, the chlorobenzene concentration has important implications for the design of the remediation wellfield. Therefore, regardless of a possible future change in the interpretation of groundwater flow direction that might be made with the new data to be available from the new monitor wells G-22 and G-23, it is necessary to be sure that monitor well G-19 is not providing erroneous data due to seepage from the Bellflower sand. Accordingly, a replacement monitor well, G-19A, will be installed immediately upgradient of monitor well G-19 to confirm the water quality in the Gage aquifer in this area. If the results from monitor well G-19A indicate that the groundwater samples obtained from monitor well G-19 are not representative of the Gage aquifer then monitor well G-19 will be properly destroyed by pressure grouting as described in Section 4.2.

4.0 PROPOSED WORK

4.1 ADDITIONAL WELLS FOR MODEL REFINEMENT

The following provides information regarding the well installation, water level measurement, and groundwater sampling of monitor wells G-19A and G-24.

4.1.1 Monitor Well Construction

Standard operating procedures (SOPs) for the drilling, construction, and development of monitor wells G-19A and G-24 are provided in Appendix A of the pCBSA Workplan (H+A, 2004c). QA/QC procedures that will be implemented during field and laboratory activities associated with this program are provided in Appendix B of the pCBSA Workplan (H+A, 2004c). All field work will be conducted in accordance with the Site-Specific Health and Safety Plan (H+A, 2003b).

As an overview, Gage aquifer monitor wells G-19A and G-24 will be installed using a mud-rotary rig in order to install a 4-inch diameter monitor well. A four-inch diameter monitor well will allow aquifer testing to be conducted at this well at a later date, if required. To prevent potential cross contamination from the underlying zones during drilling, a conductor casing will be installed and grouted in place to seal off the contaminated zones prior to drilling into the target completion zone for this well. Monitor wells G-19A and G-24 will be constructed with 4-inch diameter poly vinyl chloride screen and casing (Table 3). Preliminary monitor well construction specifications have been provided in the FSP for the pCBSA Workplan and Table 4 of this document (H+A, 2004c).

Lithologic data from the monitor well boring will be used to finalize the design of monitor wells G-19A and G-24. An exploratory boring, EB-19, will be drilled adjacent of the proposed

location of G-19A. The exploratory boring will be continuously cored and geophysically logged. Subsequent to logging, the boring will be destroyed by grouting from the bottom up using a high-solids bentonite grout.

Lithologic data from the monitor well boring will be used to finalize the design of monitor well G-24. Existing information from exploratory boring EB-15 located to the north was used to develop the preliminary design for monitor well G-24 (Figure 15; Table 3). While existing information from exploratory boring EB-15 located to the north of G-24 was used to design, monitor well G-24 for the purpose of the Workplan, the actual well design will depend on lithologic data generated from the monitor well boring.

The rationale for monitor well construction details, including well depths, screened intervals and well construction materials, is based on previously drilled borings, previous monitor well construction, and the anticipated unit thickness and contact elevations. The screen interval will be selected so that the screen begins about five feet below the top of the Gage aquifer to ensure that compounds that may be migrating through the overlying aquitard are detected. The filter pack will extend several feet above the top of the screen but will not extend into the overlying aquitard sediments to ensure that an annular seal can be placed opposite the overlying aquitard sediments. The screen length will be selected to screen the majority of the uppermost continuous coarse-grained interval of the Gage aquifer. The screen length will generally be at least 20 feet but could extend 40 or more feet depending on the thickness of coarse-grained sediments encountered. It is the intent that the groundwater samples obtained from Gage monitor wells G-19A and G-24 be representative of the interval that may be pumped during the groundwater remedy. The Workplan has been updated to provide this rationale.

The proposed location for monitor well G-19A is on the west side of Catalina Street and, thus, future development should not affect the status of this well. Prior to drilling the well in the street, an excavation permit and an encroachment permit will be obtained from the City of Los Angeles.

The proposed location for monitor well G-24 is on Normandie Avenue and, thus, future development should not affect the status of this well. Prior to drilling the wells in the street, an excavation permit and an encroachment permit will be obtained from the City of Los Angeles.

4.1.2 Water Level Measurement

Water levels will be measured at monitor wells G-19A and G-24 to evaluate horizontal and vertical hydraulic gradients and the direction of groundwater flow, and their potential impact on the current and future distribution of the Gage chlorobenzene plume. In particular, the data from monitor well G-24 will be used with similar data provided by monitor wells G-22 and G-23 being installed as part of the pCBSA Workplan (H+A, 2004c) to improve the understanding of groundwater flow directions in the vicinity of the toe of the Gage plume.

Water levels will be measured twice as part of the Additional Wells for Model Refinement task. SOPs for the measurement of water levels are provided in Appendix A of the pCBSA Workplan (H+A, 2004c). QA/QC procedures that will be implemented during field and laboratory activities associated with the Additional Wells for Model Refinement program are provided in Appendix B of the pCBSA Workplan (H+A, 2004c). All field work will be conducted in accordance with the Site-Specific Health and Safety Plan (H+A, 2003b).

4.1.3 Groundwater Sampling and Analysis

Two rounds of groundwater samples will be collected from monitor wells G-19A and G-24 for the analysis of chlorobenzene by EPA Method 8260B and pCBSA by EPA Method 314.0. SOPs for the sampling of wells are provided in Appendix A of the pCBSA Workplan (H+A, 2004c). QA/QC procedures that will be implemented during field and laboratory activities are provided in Appendix B of the pCBSA Workplan (H+A, 2004c). All field work will be conducted in accordance with the Site-Specific Health and Safety Plan (H+A, 2003b).

As an overview, an initial round of groundwater samples will be collected after the construction and development of monitor wells G-19A and G-24 have been completed. Groundwater samples collected during the initial round will be analyzed for volatile organic compounds

(VOCs), pCBSA, metals, and general minerals to provide baseline information regarding general water quality as well as the nature and extent of VOCs and pCBSA in this area of the Site.

The second round of groundwater samples will be collected approximately two weeks following the initial round of groundwater sampling. This will allow sufficient time to review the preliminary laboratory results from the initial round for anomalous data prior to conducting the second groundwater sampling round. Groundwater samples collected during the second groundwater sampling round will be analyzed for the same parameters as the first round of sampling.

Future sampling of the wells will be conducted in accordance with the sampling schedule of the Monitoring and Aquifer Compliance Plan, which is being prepared by EPA.

4.2 WELL ABANDONMENT PLAN-MONITOR WELL G-19

This portion of the Workplan is intended to fulfill the requirements for the Well Abandonment Plan Monitor DIN Suffix 045 in the event that monitor well G-19 is destroyed. The following is based on the procedures outlined in the Draft Well Maintenance and Abandonment Procedures document dated August 7, 2003 (H+A, 2003a).

4.2.1 Regulations and Guidance

Monitor well G-19 will be abandoned in accordance with the protocols provided in this document, the State of California Department of Water Resources (DWR) Water Well Standards Bulletins 74-81 and 74-90, in accordance the County of Los Angeles, Department of Health Services requirements and the conditions of the well permit (DWR, 1981; DWR, 1990). Well abandonment work will be supervised by a Registered Geologist in the State of California.

4.2.2 Well Permit and Site Clearance

A Well Decommissioning Permit will be obtained from the County of Los Angeles, Department of Health Services prior to initiation of well abandonment. The permit application process includes submitting a Site location map, well location map, well construction diagram, and description of the well destruction methodology. In addition, Underground Service Alert will be notified in advance of the field activity.

4.2.3 Groundwater Sampling

Groundwater samples will not be collected from this well since groundwater samples were collected from this well in January 2004.

4.2.4 Well abandonment procedures

The following are well abandonment procedures for monitor well G-19

4.2.4.1 Well Measurements

Well construction details will be reviewed to verify all depth intervals and volumes of required materials. Depth to water and total depth of the well will be measured prior to well abandonment. Depth to water will be measured with a flat tape sounder.

4.2.4.2 Video Logging

A borehole video camera will be used to inspect the well screen prior to well sampling and abandonment activities. The inspection system consists of a surface control unit with a video picture monitor and a high-resolution downhole camera fitted with a wide-angle lens. The inspection will be recorded on videotape and reviewed by the on-Site geologist on the day of the inspection to verify that the well screen is in satisfactory condition prior to the commencement of abandonment activities.

4.2.4.3 Abandonment Process

Any appreciable sediment observed by the video-logging that has accumulated in the well will be developed out of the well to the extent practical. Prior to grouting, the section of blank casing extending upward from the top of the well screen to the bottom of the conductor casing will be perforated using a hydraulic perforator to allow grouting of the upper filter pack interval. Unless otherwise specified, the well will be permanently abandoned in place using a cement/bentonite grout. The grout will consist of 95 percent neat cement and 5 percent bentonite. The grout will be mixed in batches prior to placement in the well. To properly mix the grout, bentonite will be mixed with water first, to fully hydrate the bentonite, prior to adding cement to the grout mixture. The premixed grout will be pumped into the well using a tremie pipe initially placed at the bottom of the well. The tremie pipe may be incrementally raised as the well is filled with grout, but will remain below the level of the grout at all times. This methodology will ensure that the grout does not bridge within the well during placement. The grout will be pumped into the well until grout fills the well. The volume of grout delivered into the well casing will be recorded throughout the field activities as a means of verifying proper well abandonment. The volume of grout placed during this phase of the abandonment should equal or exceed the empty well casing volume. Due to the weight of the grout column, some grout will typically seep into the adjacent sand pack and formation. As this seepage occurs, additional grout will be added to the well until there is no measurable change in the elevation of grout within the casing.

The well casing will then be sealed as additional grout is pumped into the well under pressure. This pressure will force grout out through the well screen and into the sand pack and formation. The amount of grout emplaced during this phase is dependent on the nature of the sand pack and adjacent formation. The casing will be pressured and grout will be added until the well/formation no longer accepts grout. During pressure grouting, a pressure cap will be placed on the well casing. The locking cap will have a valved port that grout will be pumped through. Grout will be pumped into the well casing under pressure until the formation and filter pack will no longer accept grout. Repeated attempts will be made to place grout into the well casing under pressure. If no further grout can be pumped into the well following three successive attempts, the valve on the locking well cap will be closed to shut the grout pump system pressure in the well casing prior to the pumping equipment being disconnected from the well cap. The valved pressure cap will be left in place for a length of time sufficient for the cement/bentonite grout to set.

The soil around the well casing will be excavated to a depth of five feet below grade by overdrilling the conductor casing with a large diameter hollow auger. The upper five feet of conductor casing will then be removed using a cutting torch, and the upper five feet of polyvinyl chloride casing will be removed using a hand saw. A mushroom cement cap will be placed over the cut well casing in the bottom of the excavation. Any construction debris generated during well abandonment activities will be relocated to the Montrose property pending disposal in a municipal landfill. The grout will be allowed to set for 24 hours at which time the well will be inspected to verify the level of grout, and any settlement of grout will be topped off and a new mushroom cement cap will be placed over the filled casing, if necessary. The excavation will be backfilled and the ground surface will be restored.

5.0 SCHEDULE AND REPORTING

The schedule for the Additional Wells for Model Refinement tasks is provided in Figure 21. The schedule provides details regarding the installation and reporting of the monitor wells described above, as well as the schedule of activities associated with the replacement of monitor well G-19.

5.1 WELL INSTALLATION REPORTING

Following completion of field activities, a report will be prepared and submitted to EPA. Information to be provided as part of this report is specified in the UAO SOW Task 5.6.3. The Completion Report for Additional Wells for Model Refinement will include:

- Exact locations of new monitor wells with coordinates and map showing locations relative to the Site and the surrounding area;
- Well construction details, including construction materials;
- Diagrams of well construction including well depth, casing depth, annular spacing, packing and screened interval;
- Geologic logs from well drilling and installation;
- Initial water levels and water quality data for each new well;
- Property ownership and property access issues, including permits and easements for each new well location;
- The objectives of the investigation;
- A description of the field activities documenting well drilling and construction; sampling and analysis methods and procedures; and how these may differ from the Additional Wells for Model Refinement Workplan;

- Results of any sampling or measurements;
- Graphics depicting hydrostratigraphic cross sections; and
- Any other information necessary to document the installation and sampling of the new monitor wells.

This report will be provided to EPA 20 business days after completion of the final sampling of the new monitor wells. Data collected during this program including water level data, parameter data collected during purging, and laboratory analytical data will be entered into the project database. Data will be managed in accordance with the Data Management Plan (H+A, 2004a).

5.2 MONITOR WELL G-19 ABANDONMENT REPORTING

Upon completion of the well abandonment activities, a Well Abandonment Report (DIN Suffix 046) will be prepared and submitted to EPA and the County of Los Angeles, Department of Health Services within 30 days after completion of the field work. Details regarding this deliverable are provided in the UAO SOW (EPA, 2003).

6.0 REFERENCES

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TABLE 1

CHLOROBENZENE IN GROUNDWATER

WELL IDENTIFIER	PREVIOUS RESULT (DATE)	CONCENTRATION (micrograms per liter) RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Upper Bellflower Aquitard Monitor Wells					
MW-01	78,000 (11/29/95)	1,400	-	78,000	130,000
MW-03	<1 (11/20/91)	<1	-	59	<2/<1 (SPT)
MW-04	500 (04/20/90)	58	-	1,600	3,900
MW-05	8.4 (11/28/95)	8.4	-	200,000	480/380 (FD)
MW-06	190 (12/01/95)	190	-	13,000	130/130 (FD)
MW-08	<1 (04/20/90)	<1	-	5.0	5.1
MW-09	8,400 (11/30/95)	8,400	-	180,000	320
MW-10	820 (04/20/90)	790	-	2,200	31
MW-11	20,000 (04/18/90)	18,000	-	34,000	930/780 (SPT)
MW-12	4,100 (12/02/95)	3,200	-	8,200	2,800
MW-13	2,600 (04/21/90)	1,700	-	3,200	11,000
MW-14	400 (04/17/90)	130	-	900	160/160 (SPT)
MW-16	<20 (10/14/02)	<5	-	<20	<2
MW-17	4.4 (10/15/02)	2.0	-	7.5	<2/<2 (FD)
MW-19	3.4 (11/30/95)	<1	-	9.0	3.3
MW-22	<2 (10/10/02)	<1	-	<2	<2
MW-25	210 (10/15/02)	44	-	990	340
MW-26	<2 (10/16/02)	<1	-	9.0	<2
MW-27	3.9 (12/02/95)	3.9	-	15	<2/2 (SPT)
MW-30	<2 (10/15/02)	<1	-	<2	<2
Bellflower Sand Monitor Wells					
BF-01	86 (01/25/99)	86	-	570	11
BF-02	4,700 (04/20/90)	3,600	-	16,000	47,000
BF-03	9,000 (04/20/90)	9,000	-	23,000	13,000
BF-04	30,000 (11/19/91)	23,000	-	42,000	15,000
BF-05	2 (10/14/02)	2.0	-	3,400	6.4

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TABLE 1 (continued)
CHLOROBENZENE IN GROUNDWATER

WELL IDENTIFIER	PREVIOUS RESULT (DATE)	CONCENTRATION (micrograms per liter) RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Bellflower Sand Monitor Wells (continued)					
BF-06	23,000 (01/22/99)	23,000	-	34,000	26,000
BF-07	31,000 (01/22/99)	31,000	-	66,000	25,000
BF-09	25,000 (01/25/99)	11,000	-	25,000	19,000
BF-10	<1 (01/20/99)	<1	-	<1	17
BF-11	2,300 (08/04/90)	190	-	2,300	8,800
BF-12	450 (10/08/02)	<1	-	580	330/390 (FD)
BF-14	2,000 (08/05/90)	1,200	-	2,000	730
BF-15	21,000 (01/25/99)	21,000	-	42,000	8,300
BF-16	2,000 (01/20/99)	150	-	2,000	3,000/2,700 (SPT)
BF-17	2,700 (01/22/99)	2,300	-	4,300	5,200
BF-19	<1 (01/20/99)	<1	-	<1	<2
BF-20	29 (01/21/99)	29	-	1,000	1,800/2,100**
BF-21	1,500 (01/21/99)	1,500	-	8,900	1,800/1,400 (SPT)
BF-22	450 (06/18/91)	360	-	450	420/410 (FD)
BF-24	4,300 (01/22/99)	4,300	-	17,000	18,000
BF-25	320 (01/19/99)	62	-	320	21
BF-26	5 (10/08/02)	5.0	-	46	3.6
BF-27	<2 (10/09/02)	<1	-	<2	<2/<2 (FD)
BF-28	<2 (10/08/02)	<1	-	5.0	<2
BF-29	620 (08/08/91)	270	-	620	130
BF-30	<2 (10/09/02)	<1	-	<2	<2
BF-31	18 (10/10/02)	18	-	430	21
BF-32A	24 (10/09/02)	<1	-	180	<2
BF-33	<2 (10/09/02)	<1	-	<2	<2
Gage Aquifer Monitor Wells					
G-01	190 (11/21/91)	170	-	710	990/800 (SPT)

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TABLE 1 (continued)
CHLOROBENZENE IN GROUNDWATER

WELL IDENTIFIER	PREVIOUS RESULT (DATE)	CONCENTRATION (micrograms per liter) RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Gage Aquifer Monitor Wells (continued)					
G-02	6,900 (11/21/91)	6,900	-	20,000	17,000
G-03	1,100 (01/27/93)	240	-	2,200	470
G-04	1,400 (11/21/91)	9.0	-	2,000	96/93 (FD)
G-05	14,000 (04/21/90)	1,700	-	22,000	3,500
G-06	2,400 (04/18/90)	2,100	-	4,600	2,000
G-08	75 (11/20/91)	73	-	120	710
G-09	170 (10/10/02)	<2	-	170	370
G-11	5 (10/11/02)	<1	-	5.0	15
G-13	1,700 (11/21/91)	1,100	-	1,700	4,400
G-15	11 (10/11/02)	11	-	19	13
G-16	<2 (10/11/02)	<1	-	<2	<2
G-17	200 (07/03/91)	150	-	200	430
G-18	<2 (10/08/02)	<1	-	<2	<2
G-19	7,400 (10/10/02)	<1	-	7,400	12,000
SWL0034	8,600 (07/19/00)	5,400	-	11,000	6,600
Lower Gage Monitor Wells					
LG-01	70 (08/03/90)	33	-	110	9.5
LG-02	390 (04/19/90)	180	-	390	120
Lynwood Aquifer Monitor Wells					
LW-01	83 (10/17/02)	<1	-	560	64/75 (FD)/71 (SPT)
LW-02	<2 (10/14/02)	<1	-	<2	8.4
LW-03	<2 (10/14/02)	<1	-	<2	<2
LW-04	<2 (10/11/02)	<1	-	<2	<2
LW-06	<2 (10/17/02)	<1	-	<2	<2

* = Based on original sample results only.
** = Reanalysis result
Sampling results in tabulation are original samples unless specified with the following codes:
SPT = Split Sample, FD = Duplicate Sample
< = Less than; numerical value is detection limit for analyte

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TABLE 2

PARA-CHLOROBENZENE SULFONIC ACID IN GROUNDWATER

WELL IDENTIFIER	PREVIOUS RESULT (DATE)	CONCENTRATION (micrograms per liter) RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Upper Bellflower Aquitard Monitor Wells					
MW-01	NA	NA	-	NA	770,000
MW-03	<200 (11/28/90)	<200	-	<200	<10/<2 (SPT)
MW-04	NA	NA	-	NA	9,100
MW-05	24,000 (11/27/90)	24,000	-	24,000	210/220 (FD)
MW-06	11,000 (12/01/95)	1,500	-	11,000	13,000/13,000 (FD)
MW-08	NA	NA	-	NA	<10
MW-09	NA	NA	-	NA	<10
MW-10	NA	NA	-	NA	<10
MW-11	NA	NA	-	NA	<10
MW-12	20,000 (12/02/95)	20,000	-	54,000	8,900
MW-13	NA	NA	-	NA	37,000
MW-14	5,500 (12/02/90)	5,500	-	5,500	2,400/2,100 (SPT)
MW-16	<10,000 (10/14/02)	<10,000	-	<10,000	<10
MW-17	<10,000 (10/15/02)	<100	-	<10,000	42/43 (FD)
MW-19	<100 (11/30/95)	<100	-	<200	<10
MW-22	<10,000 (10/10/02)	<10,000	-	<10,000	<10
MW-25	<10,000 (10/15/02)	<10,000	-	370	4,000
MW-26	<10,000 (10/16/02)	<20	-	<10,000	<10
MW-27	<100 (12/02/95)	<20	-	<100	<10/<2 (SPT)
MW-30	<10,000 (10/15/02)	<20	-	<10,000	<10
Bellflower Sand Monitor Wells					
BF-01	<1,000 (01/25/99)	<1,000	-	<1,000	13
BF-02	NA	NA	-	NA	28,000
BF-03	NA	NA	-	NA	61,000
BF-04	72,000 (11/29/90)	72,000	-	72,000	64,000
BF-05	<10,000 (10/14/02)	<10,000	-	7,300	18
BF-06	86,000 (01/22/99)	86,000	-	86,000	78,000

857 Rpts 2004-12 Table 02
08/05/04

TABLE 2 (continued)
PARA-CHLOROBENZENE SULFONIC ACID IN GROUNDWATER

WELL IDENTIFIER	PREVIOUS RESULT (DATE)	CONCENTRATION (micrograms per liter) RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Bellflower Sand Monitor Wells (continued)					
BF-07	83,000 (01/22/99)	8,900	-	83,000	72,000
BF-09	77,000 (01/25/99)	43,000	-	77,000	76,000
BF-10	<1,000 (01/20/99)	<1,000	-	3,200	320
BF-11	NA	NA	-	NA	29,000
BF-12	14,000 (11/22/02)	<1,000	-	14,000	11,000/9,800 (FD)
BF-14	NA	NA	-	NA	5,600
BF-15	93,000 (01/25/99)	93,000	-	93,000	38,000
BF-16	24,000 (01/20/99)	5,500	-	24,000	19,000/18,000 (FD)
BF-17	22,000 (01/22/99)	22,000	-	36,000	44,000
BF-19	<1,000 (01/20/99)	<20	-	<1,000	<10
BF-20	<1,000 (01/21/99)	<1,000	-	3,500	12,000
BF-21	17,000 (01/21/99)	17,000	-	33,000	21,000/18,000 (SPT)
BF-22	3,400 (10/16/91)	3,400	-	3,400	5,500/5,600 (FD)
BF-24	44,000 (01/22/99)	44,000	-	88,000	110,000
BF-25	<1,000 (01/19/99)	<1,000	-	8,000	570
BF-26	<10,000 (10/08/02)	<1,000	-	7,700	120
BF-27	<10,000 (10/09/02)	<1,000	-	770	<10/<10 (FD)
BF-28	<10,000 (10/08/02)	<10,000	-	2,600	1,500
BF-29	790 (10/17/91)	790	-	790	1,000
BF-30	<10,000 (10/09/02)	<20	-	<10,000	13
BF-31	<10,000 (10/10/02)	<1,000	-	7,200	150
BF-32A	<10,000 (10/09/02)	<100	-	<10,000	150/160 (FD)
BF-33	<10,000 (10/09/02)	<10,000	-	1,200	<10
Gage Aquifer Monitor Wells					
G-01	500 (12/01/90)	500	-	500	5,900/6,500 (SPT)
G-02	21,000 (12/02/90)	21,000	-	21,000	27,000

857 Rpts 2004-12 Table 02
08/05/04

TABLE 2 (continued)
PARA-CHLOROBENZENE SULFONIC ACID IN GROUNDWATER

WELL IDENTIFIER	PREVIOUS RESULT (DATE)	CONCENTRATION (micrograms per liter) RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Gage Aquifer Monitor Wells (continued)					
G-03	NA	NA	-	NA	3,700
G-04	9,300 (11/28/90)	9,300	-	9,300	470/480 (FD)
G-05	NA	NA	-	NA	8,700
G-06	NA	NA	-	NA	17,000
G-08	1,000 (12/03/90)	1,000	-	1,000	4,400
G-09	<10,000 (10/10/02)	<10,000	-	2,700	7,600
G-11	<10,000 (10/11/02)	<10,000	-	<10,000	4,800
G-13	22,000 (11/30/90)	22,000	-	22,000	26,000
G-15	<10,000 (10/11/02)	<10,000	-	170	<10
G-16	<10,000 (10/11/02)	<20	-	<10,000	<10
G-17	3,000 (10/11/91)	3,000	-	3,000	4,500
G-18	<10,000 (10/08/02)	<20	-	<10,000	<10
G-19	60,000 (10/10/02)	210	-	60,000	53,000
SWL0034	39,000 (02/14/96)	25,000	-	39,000	49,000
Lower Gage Monitor Wells					
LG-01	NA	NA	-	NA	11,000
LG-02	NA	NA	-	NA	14,000
Lynwood Aquifer Monitor Wells					
LW-01	<10,000 (10/17/02)	<10,000	-	2,100	470/500 (FD)/ 510 (SPT)
LW-02	<10,000 (10/14/02)	<100	-	1,400	<10
LW-03	<10,000 (10/14/02)	<10,000	-	<10,000	<10
LW-04	<10,000 (10/11/02)	<20	-	<10,000	<10
LW-06	<10,000 (10/17/02)	<20	-	<10,000	<10

* = Based on original sample results only.
NA = Previous samples collected from this well not analyzed for this compound
Sampling result in tabulation are original samples unless specified with the following codes:
SPT = Split Sample, FD = Duplicate Sample
< = Less than; numerical value is detection limit for analyte

857 Rpts 2004-12 Table 02
08/05/04

TABLE 3

LITHOLOGIC LOG FOR EXPLORATORY BORING EB-15

DEPTH INTERVAL (feet below land surface)	SOIL TYPE	GROUP SYMBOL(a)	DESCRIPTION OF MATERIAL
0 - 2.5	SILTY SAND	SM	Light olive brown (2.5Y 5/4), dense, fine-grained, 0.1-mm diameter.
2.5 - 5	CLAYEY SILT	ML	Very dark grayish brown (2.5Y 3/2), very stiff, low plasticity.
5 - 10	SANDY CLAYEY SILT	ML	Light olive brown (2.5Y 3/2), firm, low plasticity; sand is fine-grained, 0.1-mm diameter.
10 - 15	SANDY CLAYEY SILT/ CLAYEY SILTY SAND	ML/SM	Same as in 5- to 10-foot interval, grading to clayey silty sand, fine-grained, 0.1-mm diameter.
15 - 20	FOSSILIFER-OUS SAND	SP	Olive (5Y 5/3), fine-grained, 0.1- to 0.25-mm diameter, white shell fragments to 1-inch diameter; with cemented nodules to 0.5-inch diameter; with silt.
20 - 25	SAND/SANDY CLAYEY SILT	SP/ML	Olive (5Y 5/3), fine-grained, 0.1- to 0.25-mm diameter; with white shell fragments to 1.5-inch diameter; with cemented nodules to 0.5-inch diameter; with silt; interbedded with sandy clayey silt, firm, low plasticity.
25 - 30	FOSSILIFER-OUS SAND	SP	Olive (5Y 5/3), fine-grained; with cemented nodules to 1.5-inch diameter; with shell fragments to 0.8-inch diameter.
30 - 35	SANDY CLAYEY SILT	ML	Light olive brown (2.5Y 5/6), firm, low plasticity; interbedded with clayey silty sand, medium dense, fine-grained, 0.1-mm diameter, low plasticity.

(a) Unified Soil Classification System
ASTM D-2487

TABLE 3 (continued)
LITHOLOGIC LOG FOR EXPLORATORY BORING EB-15

DEPTH INTERVAL (feet below land surface)	SOIL TYPE	GROUP SYMBOL(a)	DESCRIPTION OF MATERIAL
35 - 45	SILTY SAND/ SANDY SILT	SM/ML	Light olive brown (2.5Y 5/6), soft; sand is fine-grained, 0.1-mm diameter; with cemented sand nodules to 0.5-inch diameter. At 40 feet, grading to sandy silt, dense; interbedded with sandy silt interbeds; silt is firm to stiff.
45 - 50	CLAYEY SILTY SAND	SM	Light olive brown (2.5Y 5/4) with reddish brown (2.5YR 4/4) and olive gray (5Y 4/2), fine-grained, 0.1- to 0.25-mm diameter, low plasticity.
50 - 55	SILTY SAND/ SANDY SILT	SM/ML	Light olive brown (2.5Y 5/4) and trace reddish brown (2.5YR 4/4) and olive gray (5Y 4/2), same characteristics as in 35- to 40-foot interval.
55 - 65	CLAYEY SANDY SILT	ML	Pale olive (5Y 6/3) with olive gray (5Y 5/2), firm, low plasticity; sand is fine-grained, 0.1-mm diameter, micaceous.
65 - 70	CLAYEY SANDY SILT/ SILTY SAND	ML/SM	Clayey sandy silt is same as in 55- to 65-foot interval; silty sand is same color, trace dark gray (5Y 4/1) coloring, fine-grained, 0.1- to 0.25-mm diameter, micaceous.
70 - 75	CLAYEY SANDY SILT	ML	Interbedded layers of olive (5Y 5/3) and dark gray (5Y 4/1), soft to firm, fine-grained, 0.1-mm diameter, low plasticity, micaceous.
75 - 80	CLAYEY SILTY SAND	SM	Dark gray (5Y 4/1) with some olive (5Y 5/3), low plasticity, micaceous; with interbeds of clayey sandy silt (ML), same color, firm, low plasticity, more plastic than clayey silty sand, micaceous.

(a) Unified Soil Classification System
ASTM D-2487

TABLE 3 (continued)
LITHOLOGIC LOG FOR EXPLORATORY BORING EB-15

DEPTH INTERVAL (feet below land surface)	SOIL TYPE	GROUP SYMBOL(a)	DESCRIPTION OF MATERIAL
80 - 85	CLAYEY SANDY SILT	ML	Olive (5Y 5/3) with dark gray (5Y 4/1), firm, slightly to moderately plastic; with silty sand interbeds (SM), fine-grained, 0.1- to 0.25-mm diameter, micaceous.
85 - 95	CLAYEY SILTY SAND/ SANDY SILT	SM/ML	Olive (5Y 5/3), firm, sand is fine-grained, 0.1- to 0.25-mm diameter, low plasticity. At 90 feet, grading to predominantly dark gray (5Y 4/1).
95 - 105	FOSSILIFEROUS SAND	SP	Olive (5Y 5/3), fine-grained, 0.25-mm diameter, shell fragments to 0.8-inch diameter; with clayey sandy silt (ML) interbeds, same color, soft, low plasticity. At 100 feet, clayey sandy silt interbeds grade to clayey silty sand/sandy silt, firm, sand is fine-grained, 0.1- to 0.25-mm diameter, low plasticity.
105 - 110	SILTY SAND	SM	Olive (5Y 5/3), fine-grained, 0.25-mm diameter; trace multicolored medium-grained sand, 0.5-mm diameter; shell fragments to 0.3-inch diameter; with clayey sandy silt interbeds, same as in 95- to 100-foot interval.
110 - 125	SAND	SP	Olive (5Y 5/3), medium-grained, well sorted, 0.5-mm diameter; multicolored medium grains; with fine-grained sand, 0.25-mm diameter; trace shell fragments to 0.1-inch diameter. At 124 feet, silty sand (SM), fine-grained.

(a) Unified Soil Classification System
ASTM D-2487

TABLE 3 (continued)
LITHOLOGIC LOG FOR EXPLORATORY BORING EB-15
Page 4 of 6

DEPTH INTERVAL (feet below land surface)	SOIL TYPE	GROUP SYMBOL(a)	DESCRIPTION OF MATERIAL
125 - 130	CLAYEY SANDY SILT	ML	Olive (5Y 5/3), soft, low plasticity; sand is fine-grained, 0.1-mm diameter.
130 - 134	SAND	SP	Gray (5Y 5/1), fine-grained, 0.1-mm diameter, micaceous.
134 - 150	SILTY SAND	SM	Gray (5Y 5/1), fine- to medium-grained, 0.1- to 1-mm diameter; with multicolored grains. At 140 feet, medium-grained sand is olive gray (5Y 4/2), sand is well graded.
150 - 165	SAND	SW	Gray (5Y 5/1), fine- to medium-grained, 0.25- to 1-mm diameter, well graded.
165 - 190	SAND	SP	Gray (5Y 5/1), fine-grained, 0.1- to 0.25-mm diameter; with interbeds of clayey sandy silt, olive gray (5Y 5/2), soft, low plasticity. At 170 feet, no clayey sandy silt interbeds. At 175 feet, fine-grained, 0.1-mm diameter; trace cemented sand nodules; trace wood fragments to 0.3-inch diameter; trace shell fragments to 0.5-inch diameter. At 180 feet, increasing amount of wood and shell fragments. At 185 feet, abundant wood fragments; with silty sand.

(a) Unified Soil Classification System
ASTM D-2487

TABLE 3 (continued)
LITHOLOGIC LOG FOR EXPLORATORY BORING EB-15

DEPTH INTERVAL (feet below land surface)	SOIL TYPE	GROUP SYMBOL(a)	DESCRIPTION OF MATERIAL
190 - 200	FOSSILIFER-OUS SAND	SP	Same as 185- to 190-foot interval, no more wood fragments, pink and white shell fragments and whole shells to 1-inch diameter. At 195 feet, with sandy silt interbeds, soft; trace cemented sand nodules to 0.3-inch diameter.
200 - 205	CLAYEY SILTY SAND/ SANDY SILT	SM/ML	Gray (5Y 4/1), fine-grained, 0.1-mm diameter; silt is medium dense, low plasticity, micaceous.
205 - 213	CLAYEY SANDY SILT	ML	Same as in 200- to 205-foot interval.
213 - 230	SAND	SP	Gray (5Y 4/1), fine-grained. At 215 feet, olive gray (5Y 5/2), medium-grained with some fine-grained, 1-mm and 0.25-mm diameter; trace multicolored grains, subangular; trace shell fragments; with clayey silt interbeds, gray (5Y 4/1), firm, low plasticity. At 225 feet, no silty interbeds; no shell fragments.
230 - 240	SANDY CLAYEY SILT	ML	Olive gray (5Y 5/2) with olive (5Y 5/3), soft, low plasticity; sand is medium-grained with fine-grained, 1-mm and 0.25-mm diameter; with silty sand.

(a) Unified Soil Classification System
ASTM D-2487

TABLE 3 (continued)
LITHOLOGIC LOG FOR EXPLORATORY BORING EB-15

DEPTH INTERVAL (feet below land surface)	SOIL TYPE	GROUP SYMBOL(a)	DESCRIPTION OF MATERIAL
			From 235 feet, interbedded with silty clay, firm to stiff, slightly to moderately plastic.
240 - 245	SANDY CLAYEY SILT/SILTY CLAY	ML/CL	Sandy clayey silt same as in 235- to 240-foot interval; grading to silty clay, olive (5Y 5/3), slightly to moderately plastic.

TOTAL DEPTH OF BOREHOLE = 245 FEET

(a) Unified Soil Classification System
ASTM D-2487

TABLE 4

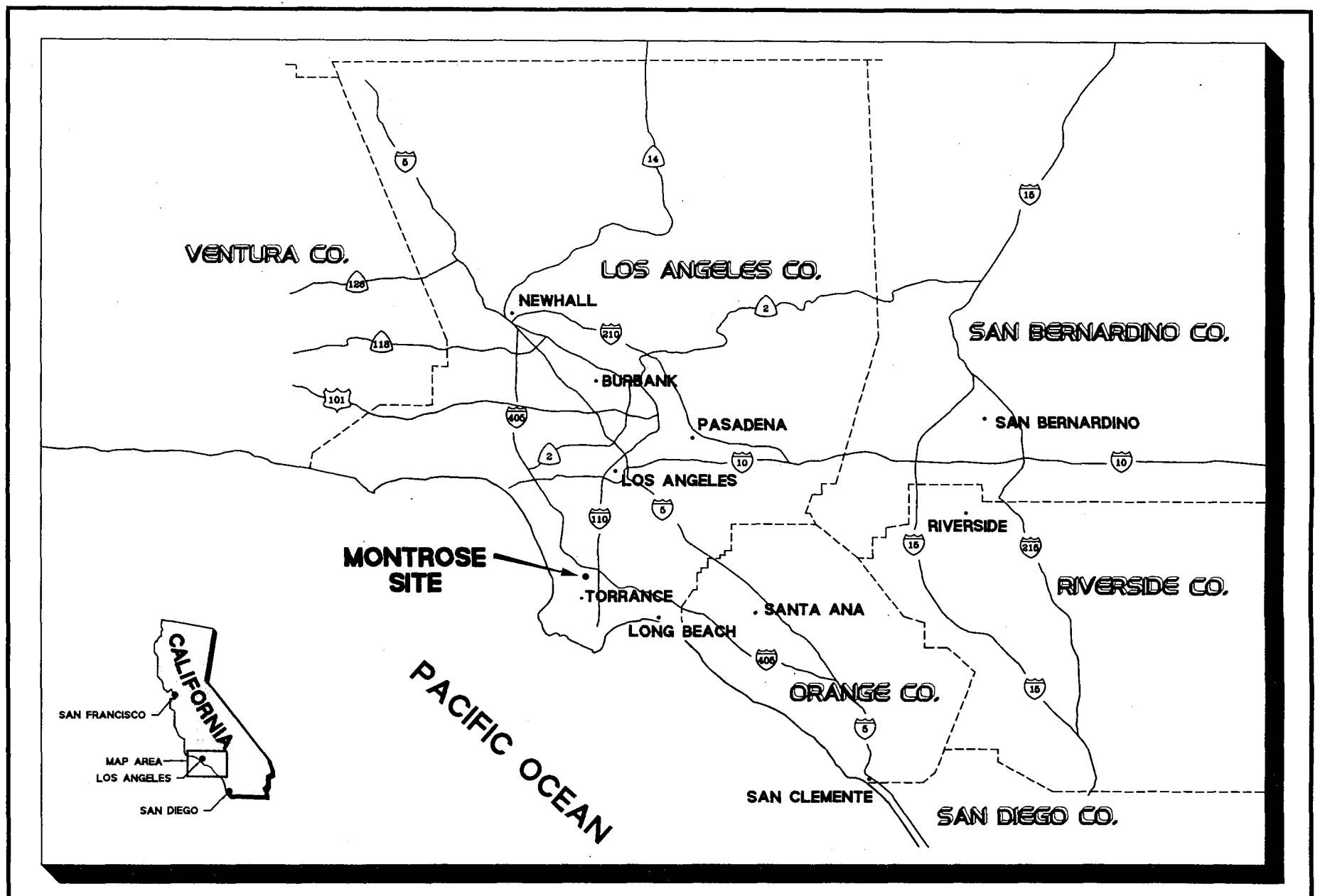
TENTATIVE WELL CONSTRUCTION DATA
FOR
PROPOSED GAGE AQUIFER MONITOR WELLS G-19A AND G-24

WELL IDENTIFIER	TOTAL DEPTH DRILLED (feet bls) (a)	BOREHOLE DIAMETER	CONDUCTOR CASING INTERVAL (feet bls)	4-INCH DIAMETER PVC BLANK CASING INTERVAL (feet bls)(a,g)	4-INCH DIAMETER PVC SCREEN INTERVAL (feet bls)(a,g)	SCREEN SLOT SIZE (inches)(b)	FILTER PACK SIZE(c)	FILTER PACK INTERVAL (feet bls)(a)	FINE SAND SEAL INTERVAL (feet bls)(a,d)	BENTONITE SEAL INTERVAL (feet bls)(a,e)	GROUT SEAL (feet bls)(a,f)
G-19A	190	12.75	0-150	0-155	158-188	0.020	#2/16	156-190	154-156	148-154	0-148
G-24	170	8/17.5	0-125	0-150	137-167	0.020	#2/16	134-170	132-134	123-132	0-123

FOOTNOTES

Ft bls= Feet below land surface.
PVC = Polyvinyl Chloride.

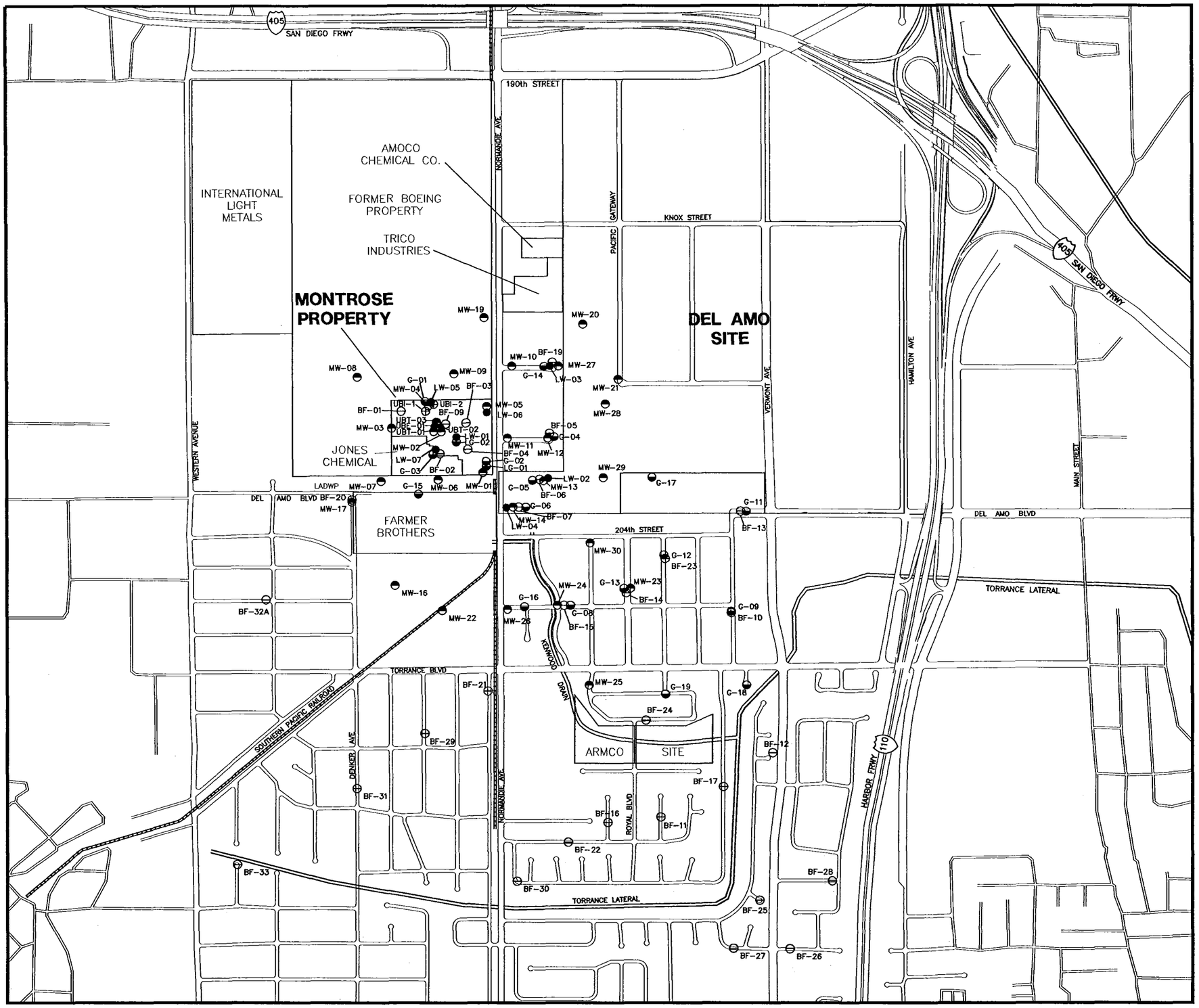
(a) Depths are approximate and will be adjusted in the field based on the lithology encountered.
(b) Screen slot size is approximate and may be adjusted based on the lithology of the screened interval.
(c) Filter pack size is approximate and may be adjusted based on the screen slot size that is selected for the well. Filter pack consists of Monterey sand. Filter pack sizes are Lone Star Lapis Lustre size designations.
(d) #60 silica sand.
(e) Granular bentonite or pellets.
(f) Volclay grout or equivalent.
(g) Schedule 80 PVC.



HARGIS + ASSOCIATES, INC.

RPT NO. 857 | 410-3831 | A

FIGURE 1. SITE LOCATION



EXPLANATION

- MW-25 — UPPER BELLFLOWER AQUITARD MONITOR WELL
- UBE-1 — UPPER BELLFLOWER AQUITARD EXTRACTION WELL
- UBT-3 — UPPER BELLFLOWER AQUITARD OBSERVATION WELL
- UBI-1 — UPPER BELLFLOWER AQUITARD INJECTION WELL
- BF-17 — BELLFLOWER SAND MONITOR WELL
- G-7 — GAGE AQUIFER MONITOR WELL
- LW-7 — LYNWOOD AQUIFER MONITOR WELL

NOTE: THIS MAP SHOWS LOCATIONS FOR MONITOR WELLS CONSTRUCTED BY MONTROSE DURING REMEDIAL INVESTIGATION ACTIVITIES AND DOES NOT INCLUDE MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY OTHERS FOR OTHER INVESTIGATIONS.

0 1,000 2,000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

MONITOR WELL LOCATIONS

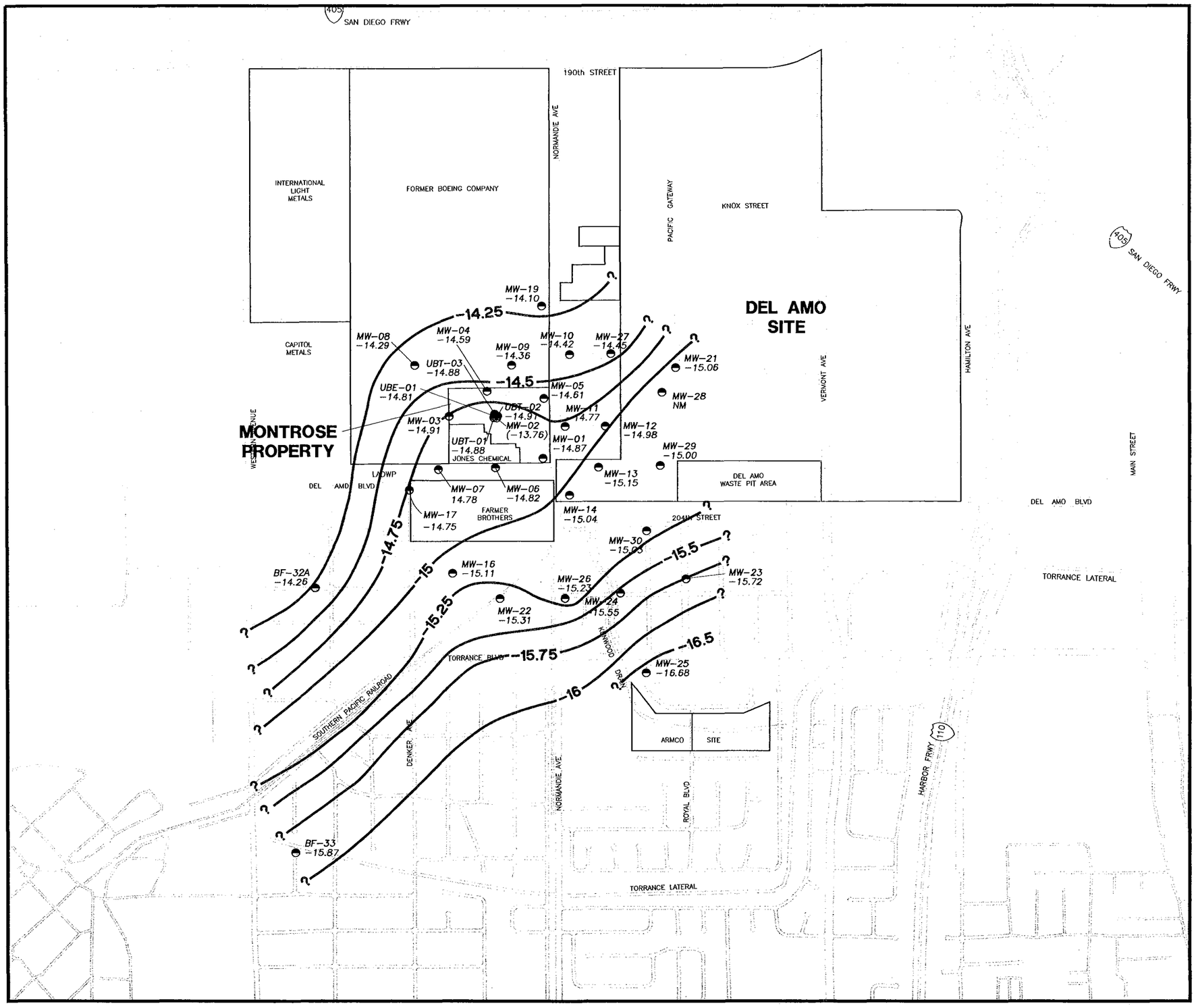
HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

05/04

FIGURE 2

PREP BY SPN REV BY MAP RPT NO. 857.38 | 410-4696 | A

BOE-C6-0012774



EXPLANATION

MW-19	UPPER BELLFLOWER AQUITARD MONITOR WELL
UBE-1	UPPER BELLFLOWER AQUITARD EXTRACTION WELL
UBT-3	UPPER BELLFLOWER AQUITARD OBSERVATION WELL
-14.2	WATER LEVEL ELEVATION (FEET MEAN SEA LEVEL)
( )	NOT CONTOURED
NM	NOT MEASURED
*	FREE PRODUCT ENCOUNTERED. WATER LEVEL ELEVATION ADJUSTED FOR PRESENCE OF PRODUCT

? ——— -18 ——— ?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12–13, 2004 WATER LEVELS AT MW-01, MW-02, MW-03 AND MW-05 MEASURED FEBRUARY 6, 2004

0 1,000 2,000

FEET

MONTROSE CHEMICAL CORPORATION

TORRANCE, CALIFORNIA

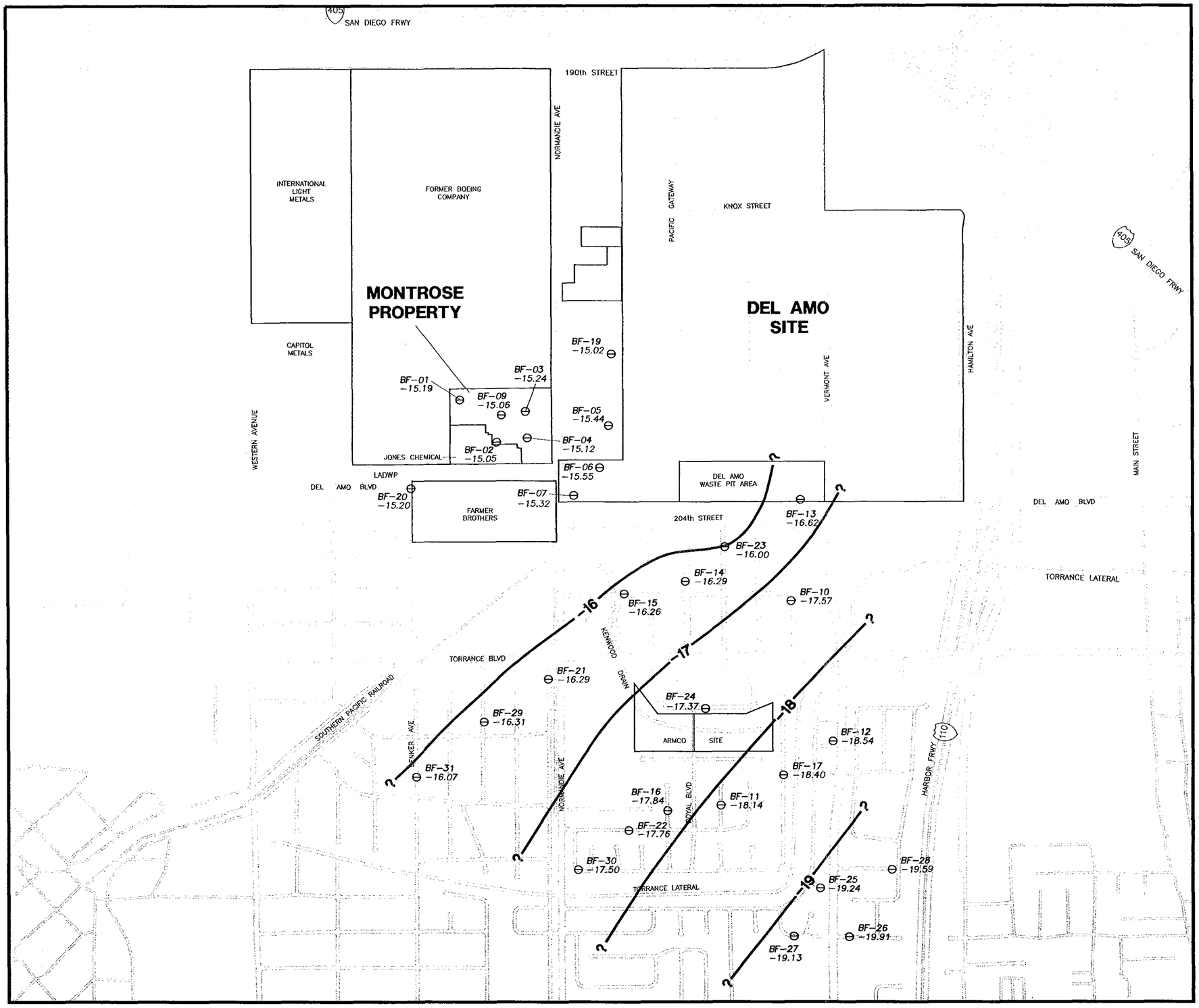
UPPER BELLFLOWER AQUITARD WATER LEVEL ELEVATION JANUARY 2004

HARGIS + ASSOCIATES, INC. Hydrogeology/Engineering

05/04

FIGURE 3

PREP BY EJB REV BY MAP RPT NO. 857.38 | 220-1481 | A



EXPLANATION

BF-07 ⊖ BELLFLOWER SAND MONITOR WELL

-15.32 WATER LEVEL ELEVATION FEET MEAN SEA LEVEL

? —— -18 —— ? CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12–14, 2004
WATER LEVELS AT BF-01, BF-03, BF-06, BF-09, BF-10 MEASURED FEBUARY 6, 2004

0 1,000 2,000
FEET

MONTROSE CHEMICAL CORPORATION
TORRANCE, CALIFORNIA

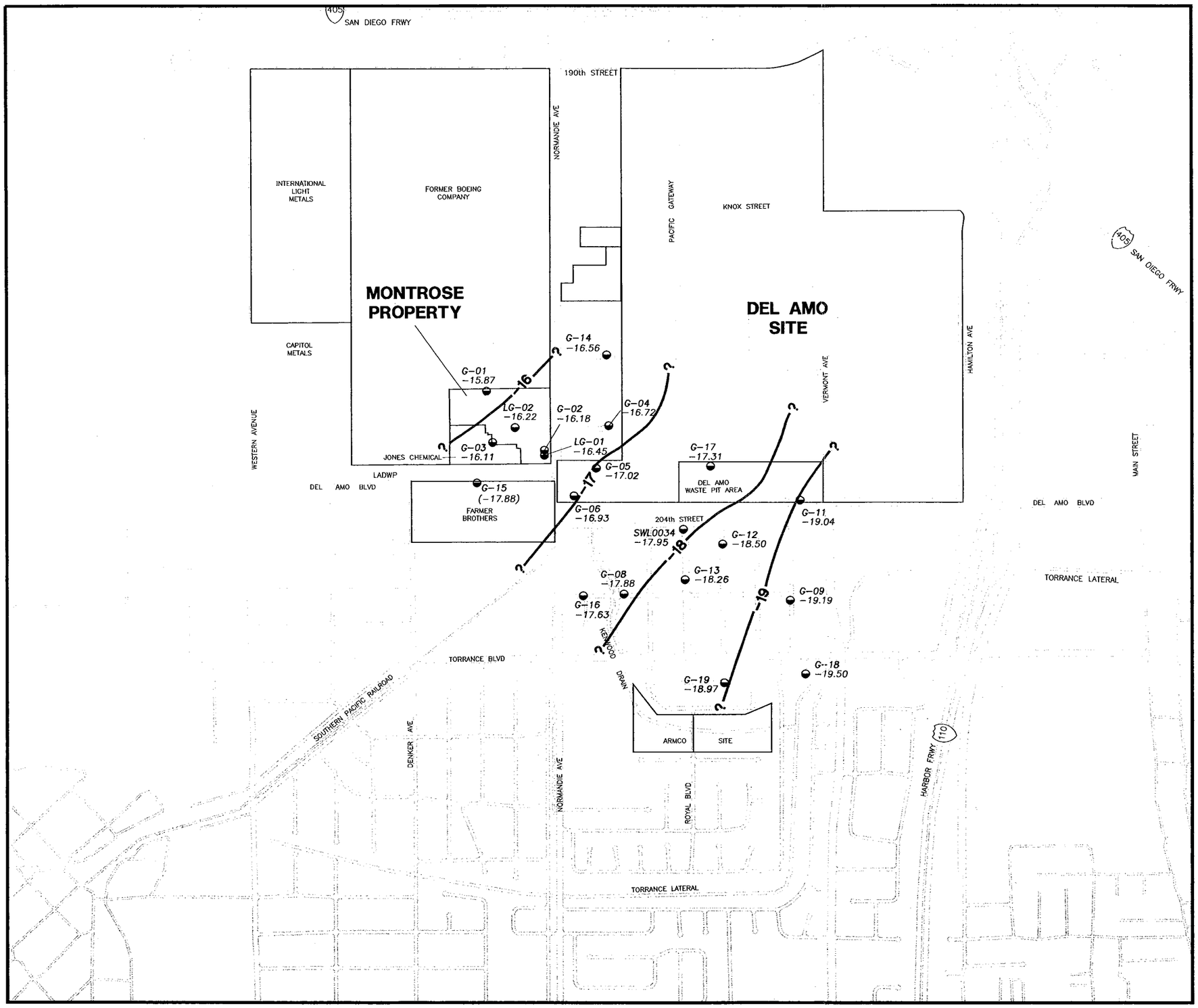
BELLFLOWER SAND WATER LEVEL ELEVATION JANUARY 2004

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

05/04

FIGURE 4

PREP BY EJB REV BY MAP RPT NO. 857.38 | 220-1478 | A



EXPLANATION

G-04 — GAGE AQUIFER MONITOR WELL

-16.72 — WATER LEVEL ELEVATION FEET MEAN SEA LEVEL

( ) — NOT CONTOURED

? —— -18 —— ? CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12–19, 2004

0 1,000 2,000

FEET

MONTROSE CHEMICAL CORPORATION

TORRANCE, CALIFORNIA

GAGE AQUIFER WATER LEVEL ELEVATION JANUARY 2004

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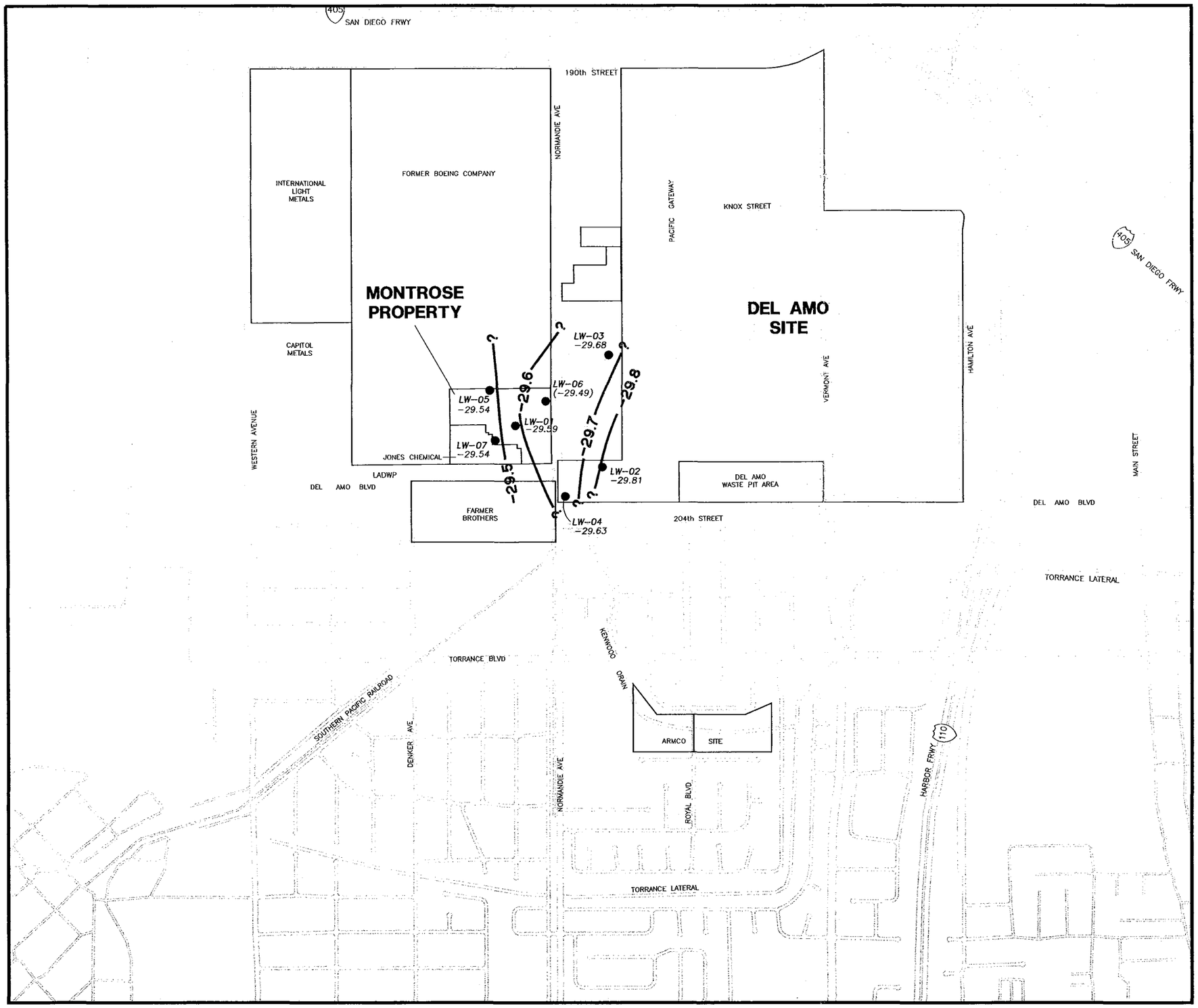
Hydrogeology/Engineering

05/04

FIGURE 5

PREP BY EJB REV BY MAP RPT NO. 857.38 | 220-1479 | A



EXPLANATION

LW-01 ●	LYNWOOD AQUIFER MONITOR WELL
-29.59	WATER LEVEL ELEVATION (FEET MEAN SEA LEVEL)
( )	NOT CONTOURED

? —— 29.7 —— ?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12–13, 2004

0 1,000 2,000

FEET

MONTROSE CHEMICAL CORPORATION
TORRANCE, CALIFORNIA

LYNWOOD AQUIFER WATER LEVEL ELEVATION JANUARY 2004

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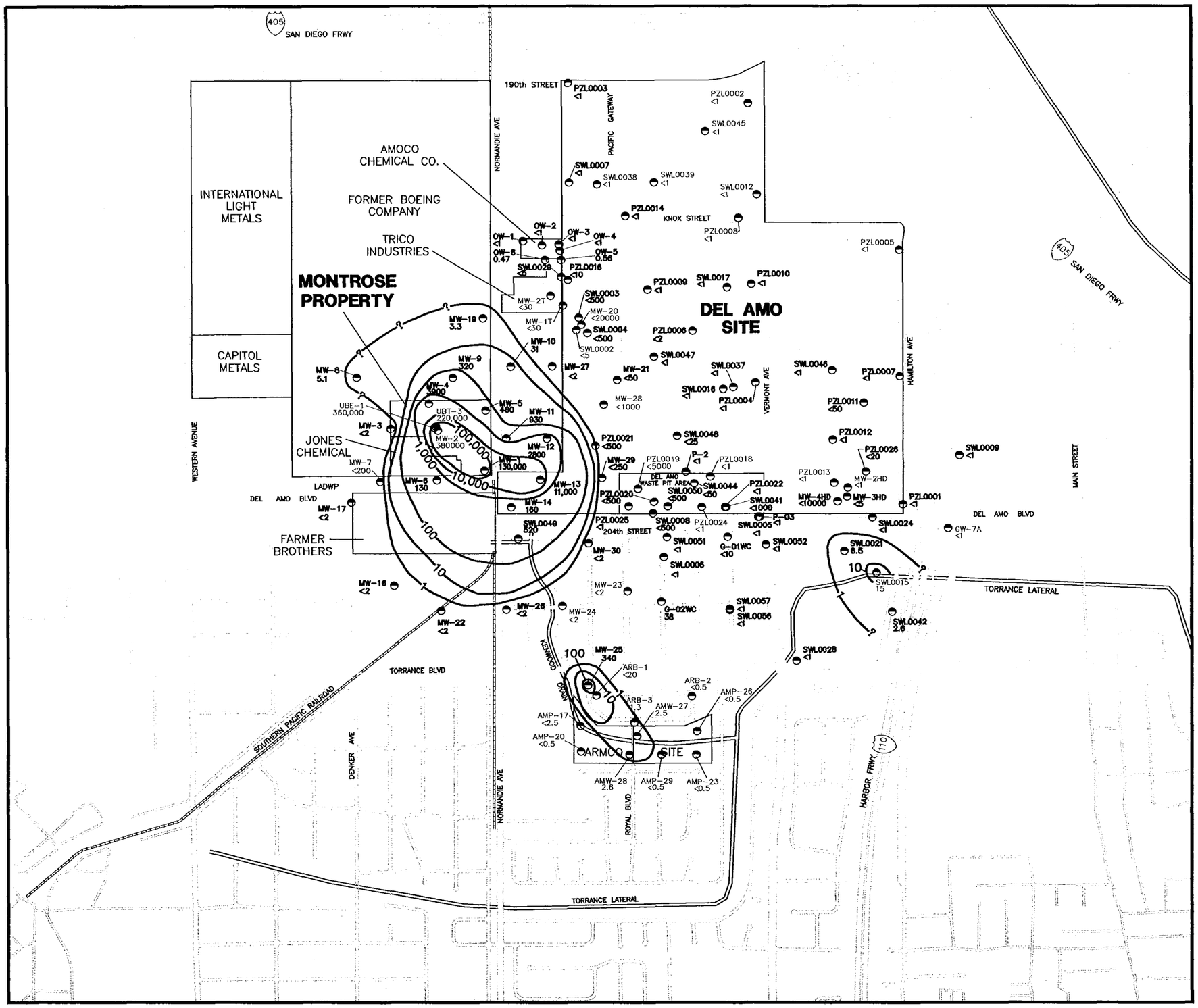
04/04

FIGURE 6

PREP BY EJB REV BY MAP RPT NO. 857.38 | 220-1482 | A

BOE-C6-0012778



EXPLANATION

MW–17	UPPER BELLFLOWER AQUITARD MONITOR WELL
<2	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004.
3.4	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO 2004.
(8.4)	CONCENTRATION NOT CONTOURED
?——1,000—— ——?	CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.
< =	LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
MW = MONTROSE MONITOR WELLS
SWL, PZL, GW, P, AND MW–_HD = DEL AMO MONITOR WELLS
AMW, AMP, AND ARB = ARMCO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON–MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

0 1000 2000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

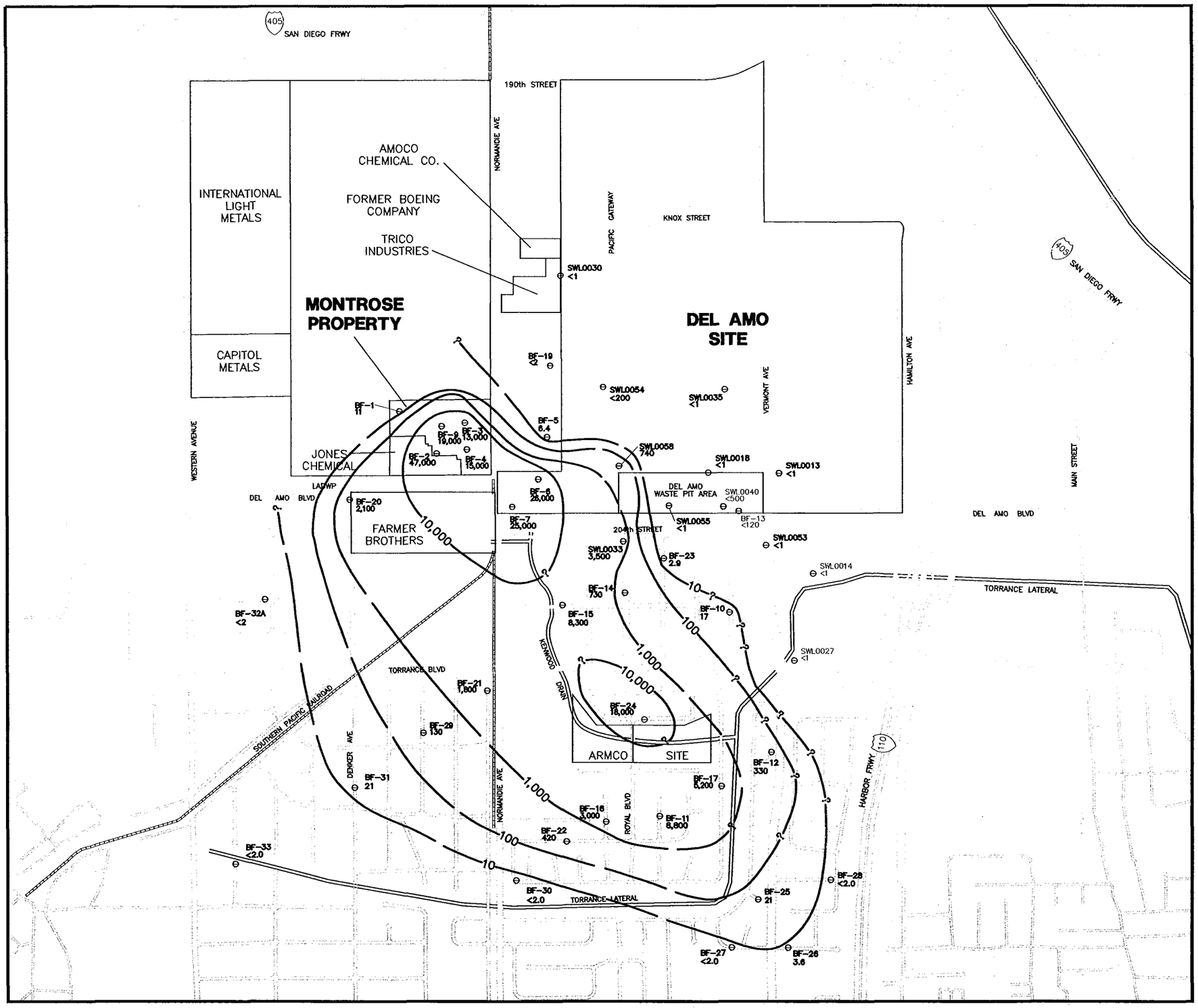
CHLOROBENZENE
UPPER BELLFLOWER AQUITARD

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

05/04

FIGURE 7

PREP BY EJB REV BY MAP RPT NO. 857.38 | 210-2289 | A



EXPLANATION

BF-15 ⊖ 8,300	BELLFLOWER SAND MONITOR WELL CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004.
270	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO 2004.

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED
BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

0 1000 2000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROBENZENE
BELLFLOWER SAND

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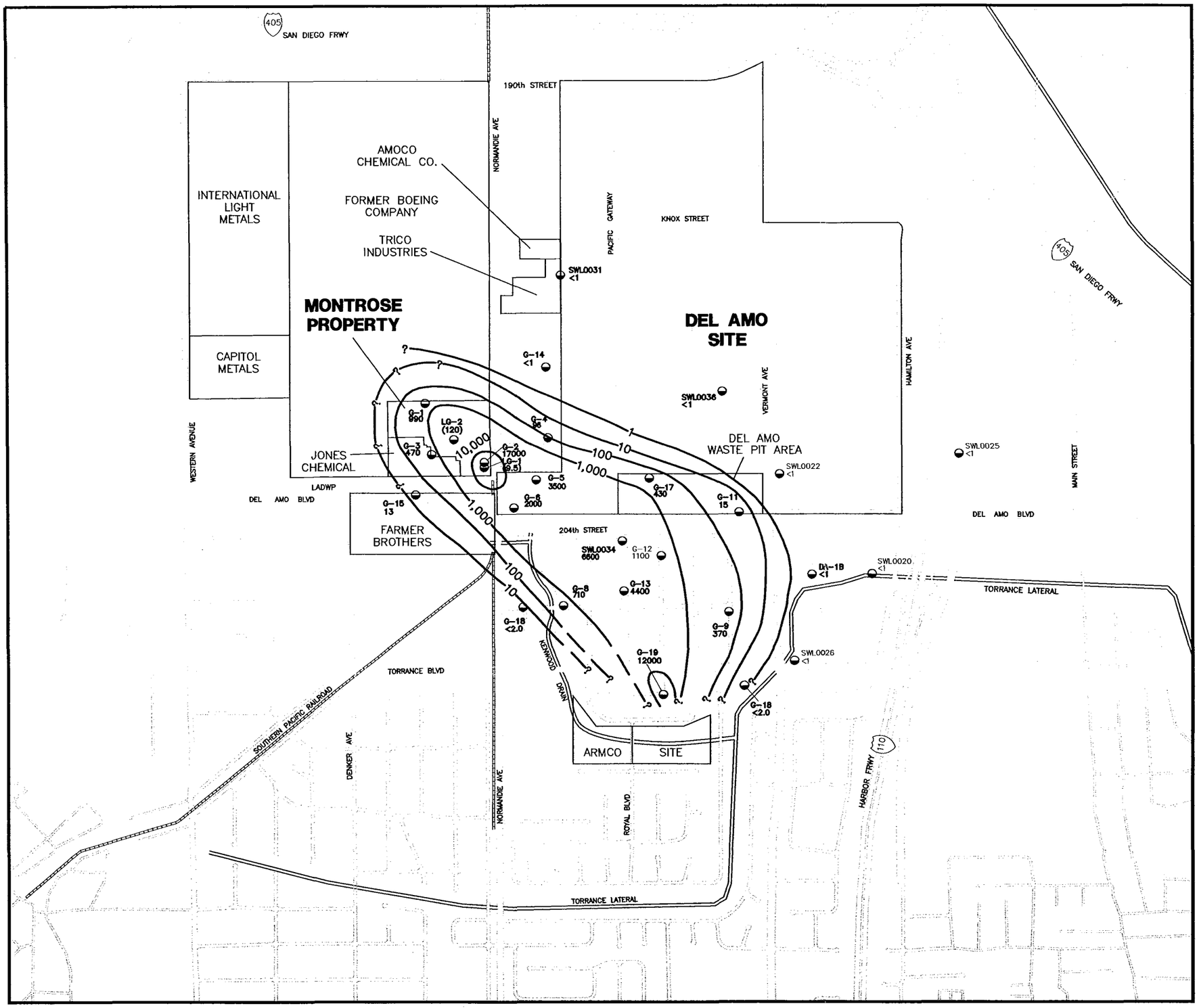
FIGURE 8

PREP BY EJB REV BY MAP RPT NO. 857.38 | 210-2290 | A

BOE-C6-0012780



EXPLANATION

G-4 ◒ 96 — GAGE AQUIFER MONITOR WELL; CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004.

<1 — CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO 2004.

LG-2 ◒ — LOWER GAGE AQUIFER MONITOR WELL CONCENTRATION IN MICROGRAMS PER LITER

(120) — NOT CONTOURED

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
G AND LG = MONTROSE MONITOR WELLS
DA AND SWL = DEL AMO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

N

0 1000 2000

FEET

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TORRANCE, CALIFORNIA

CHLOROBENZENE
GAGE AQUIFER

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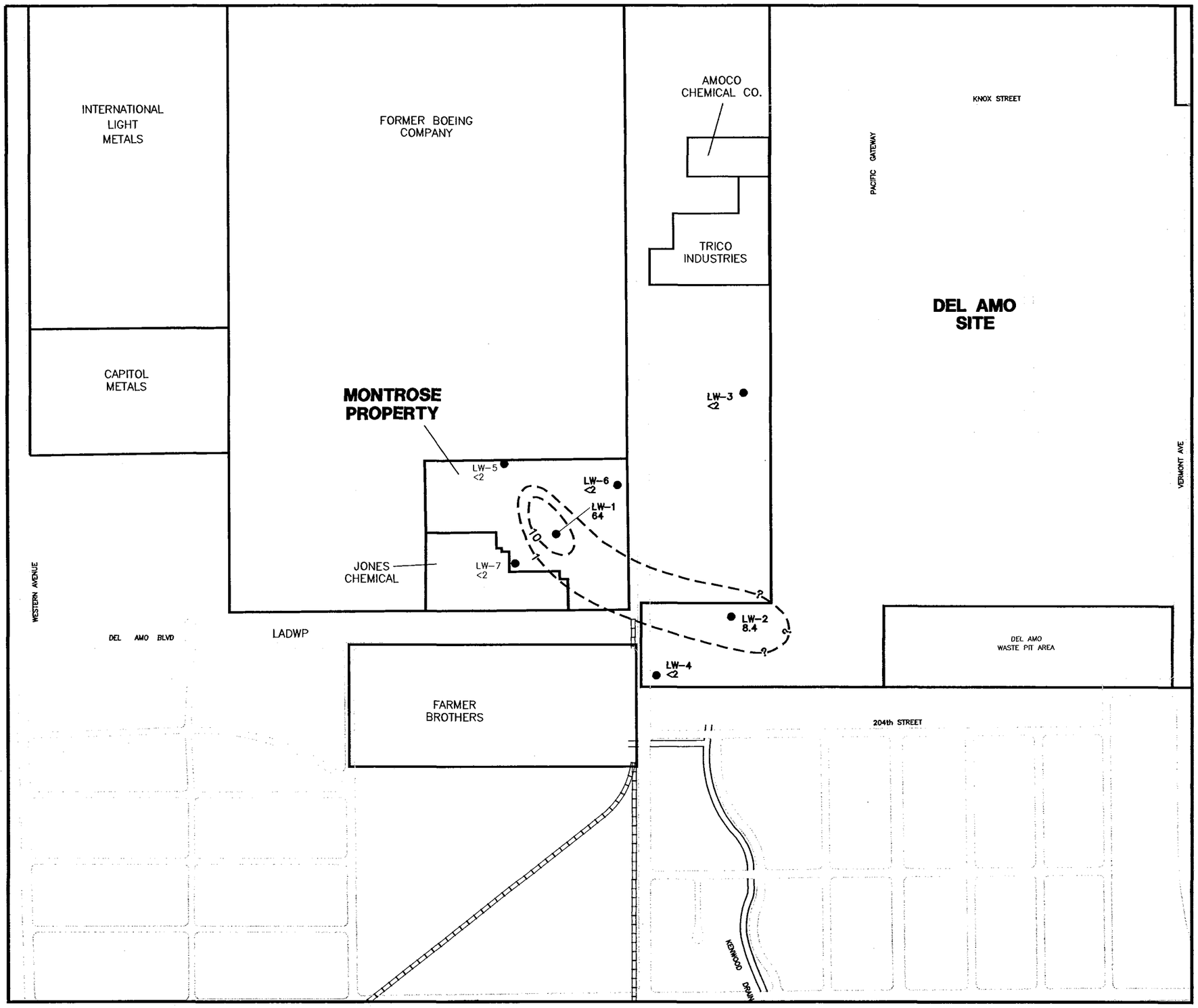
FIGURE 9

PREP BY EJB REV BY MAP RPT NO. 857.38 | 210-2291 | A



EXPLANATION

LW-4 ● LYNWOOD AQUIFER MONITOR WELL

<2 CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004.

<2 CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO JANUARY 2004.

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

0 500 1000

FEET

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OF CALIFORNIA
TORRANCE, CALIFORNIA

CHLOROBENZENE
LYNWOOD AQUIFER

HARGIS + ASSOCIATES, INC.
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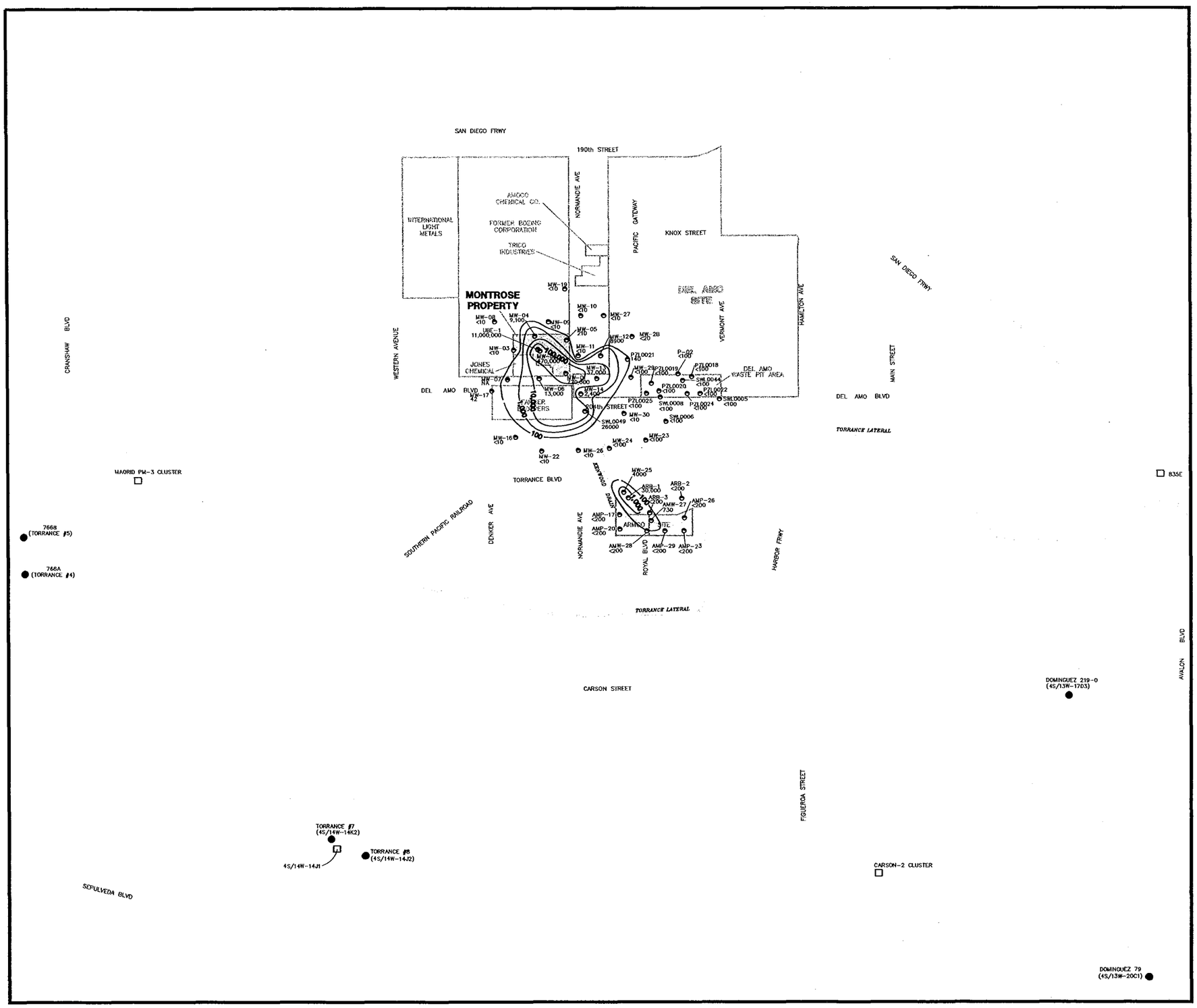
FIGURE 10

PREP BY EJB REV BY MAP RPT NO. 857.38 | 210-2292 | A



EXPLANATION

MW-26 — UPPER BELLFLOWER AQUITARD MONITOR WELL

<10 — CONCENTRATION IN MICROGRAMS PER LITER

MUNICIPAL PUBLIC WATER SUPPLY WELL

OBSERVATION OR TEST WELL

?————100—— ——?
CONTOUR LINE OF EQUAL CONCENTRATION OF pCBSA IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NA = NOT ANALYZED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS CONSTITUENT.

835E — WELL NUMBERING SYSTEM USED BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS (LACDPW), FORMERLY LOS ANGELES COUNTY FLOOD CONTROL DISTRICT (LACFCD)

4S/14W-14K2 — WELL NUMBERING SYSTEM USED BY THE STATE OF CALIFORNIA, DEPARTMENT OF WATER RESOURCES

NOTE:
WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004.
DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

0 1,800 3,600
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

pCBSA
UPPER BELLFLOWER AQUITARD

HARGIS + ASSOCIATES, INC.
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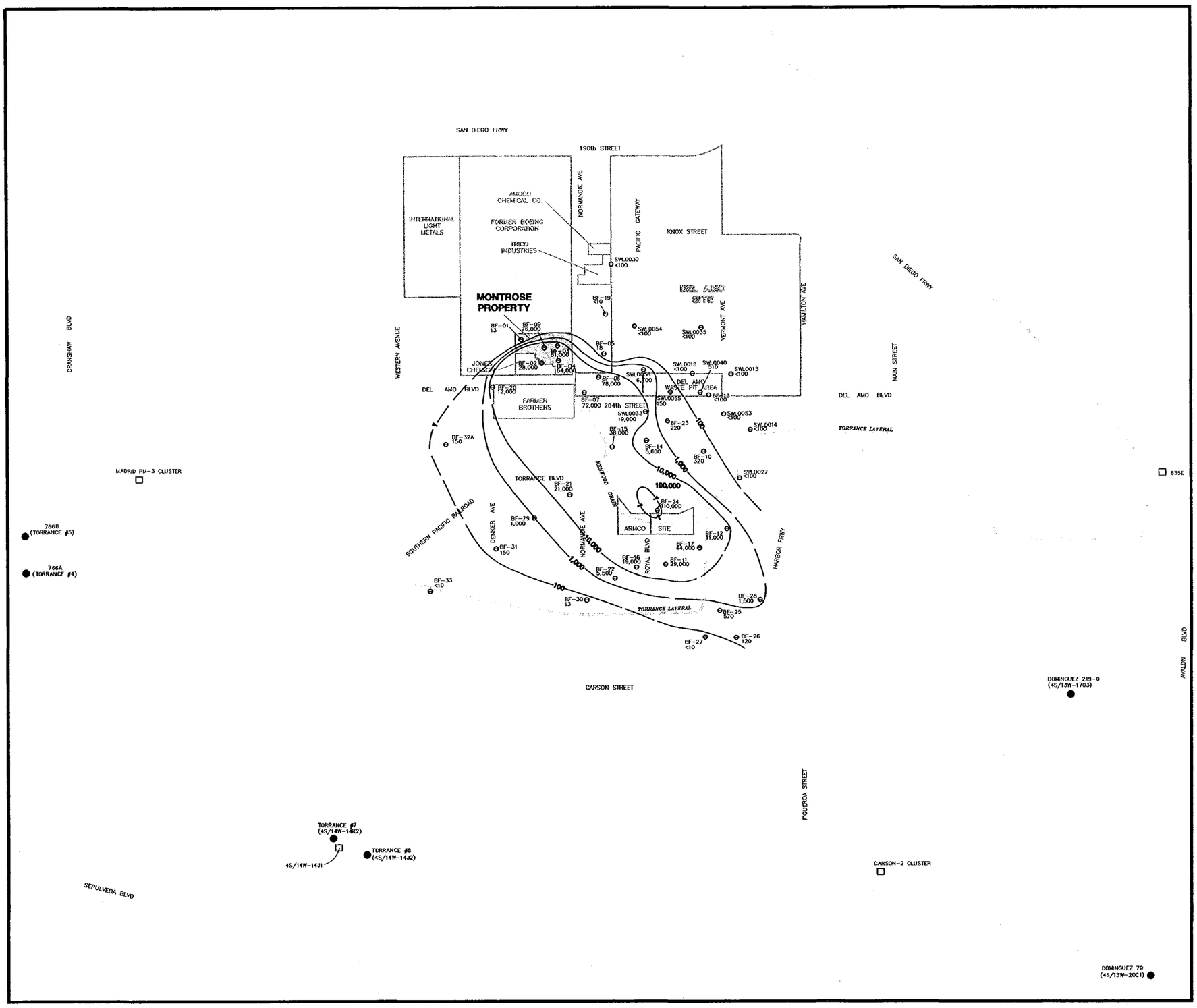
07/04

FIGURE 11

PREP BY GTC REV BY MAP RPT NO. 857.34 | 210-2340 | A



EXPLANATION

BF-5 ⊖ BELLFLOWER SAND MONITOR WELL

18 CONCENTRATION IN MICROGRAMS PER LITER

● MUNICIPAL PUBLIC WATER SUPPLY WELL

□ OBSERVATION OR TEST WELL

?————100———— ——?

CONTOUR LINE OF EQUAL CONCENTRATION OF pCBSA IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS CONSTITUENT.

835E WELL NUMBERING SYSTEM USED BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS (LACDPW), FORMERLY LOS ANGELES COUNTY FLOOD CONTROL DISTRICT (LACFCD)

4S/14W-14K2 WELL NUMBERING SYSTEM USED BY THE STATE OF CALIFORNIA, DEPARTMENT OF WATER RESOURCES

NOTE:

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N

0 1,800 3,600

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

pCBSA
BELLFLOWER SAND

HARGIS + ASSOCIATES, INC.
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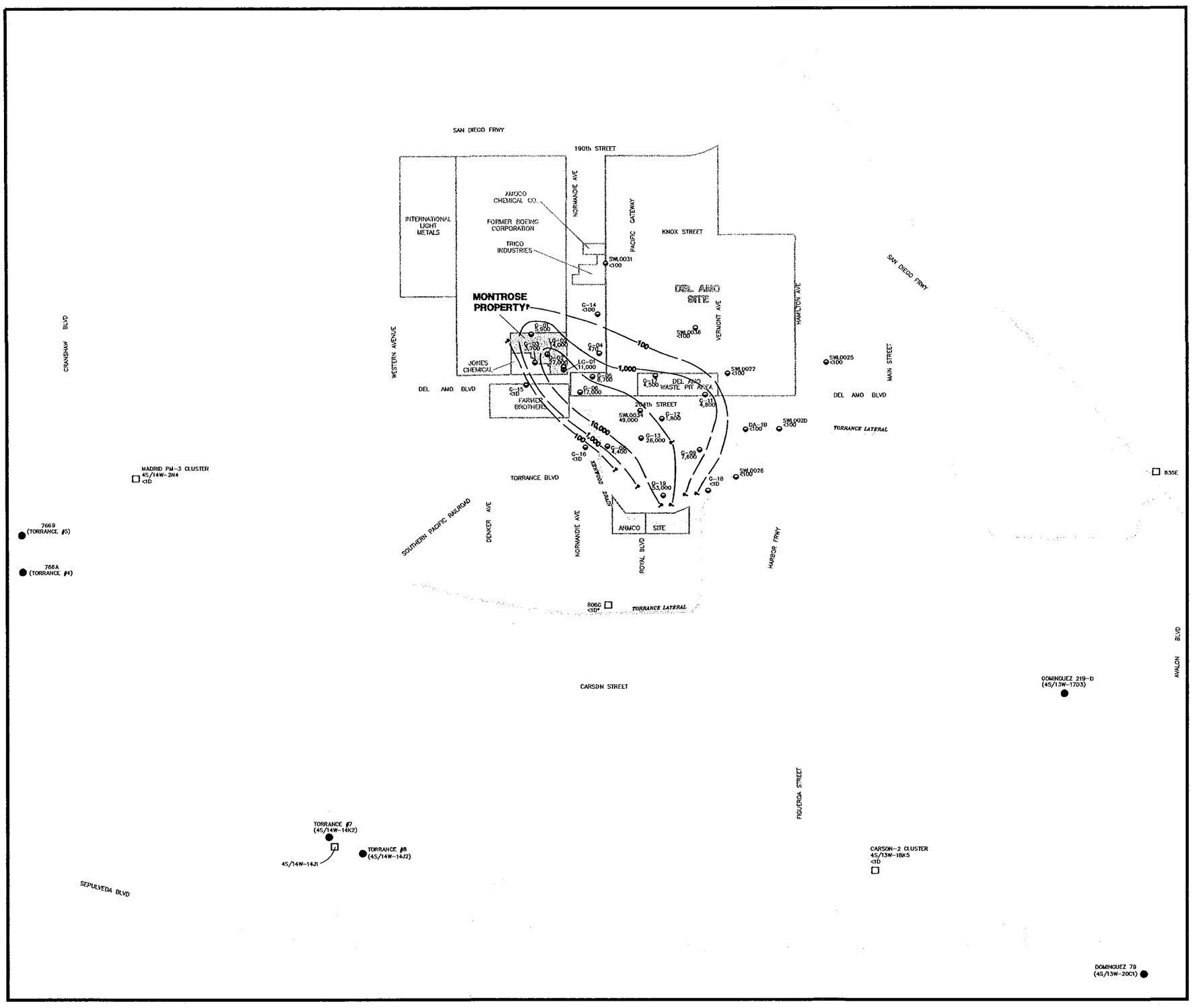
FIGURE 12

PREP BY GTC REV BY MAP RPT NO. 857.26 | 210-2338 | A



EXPLANATION

G-09 — GAGE AQUIFER MONITOR WELL

7,600 — CONCENTRATION IN MICROGRAMS PER LITER

● — MUNICIPAL PUBLIC WATER SUPPLY WELL

□ — OBSERVATION OR TEST WELL

?————100———— ——? — CONTOUR LINE OF EQUAL CONCENTRATION OF pCBSA IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS CONSTITUENT.

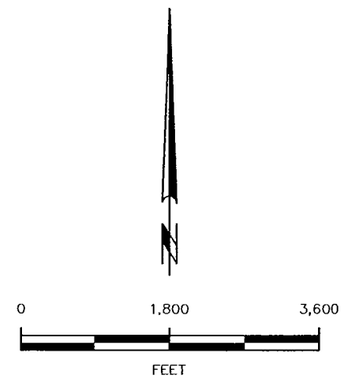
835E — WELL NUMBERING SYSTEM USED BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS (LACDPW), FORMERLY LOS ANGELES COUNTY FLOOD CONTROL DISTRICT (LACFCD)

4S/14W-14K2 — WELL NUMBERING SYSTEM USED BY THE STATE OF CALIFORNIA, DEPARTMENT OF WATER RESOURCES

* — pCBSA RESULT FROM 806C IS SUSPECT. WELL WAS BLOCKED APPROXIMATELY 2.5 FEET BELOW THE WATER LEVEL IN THE WELL.

NOTE:

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.



MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

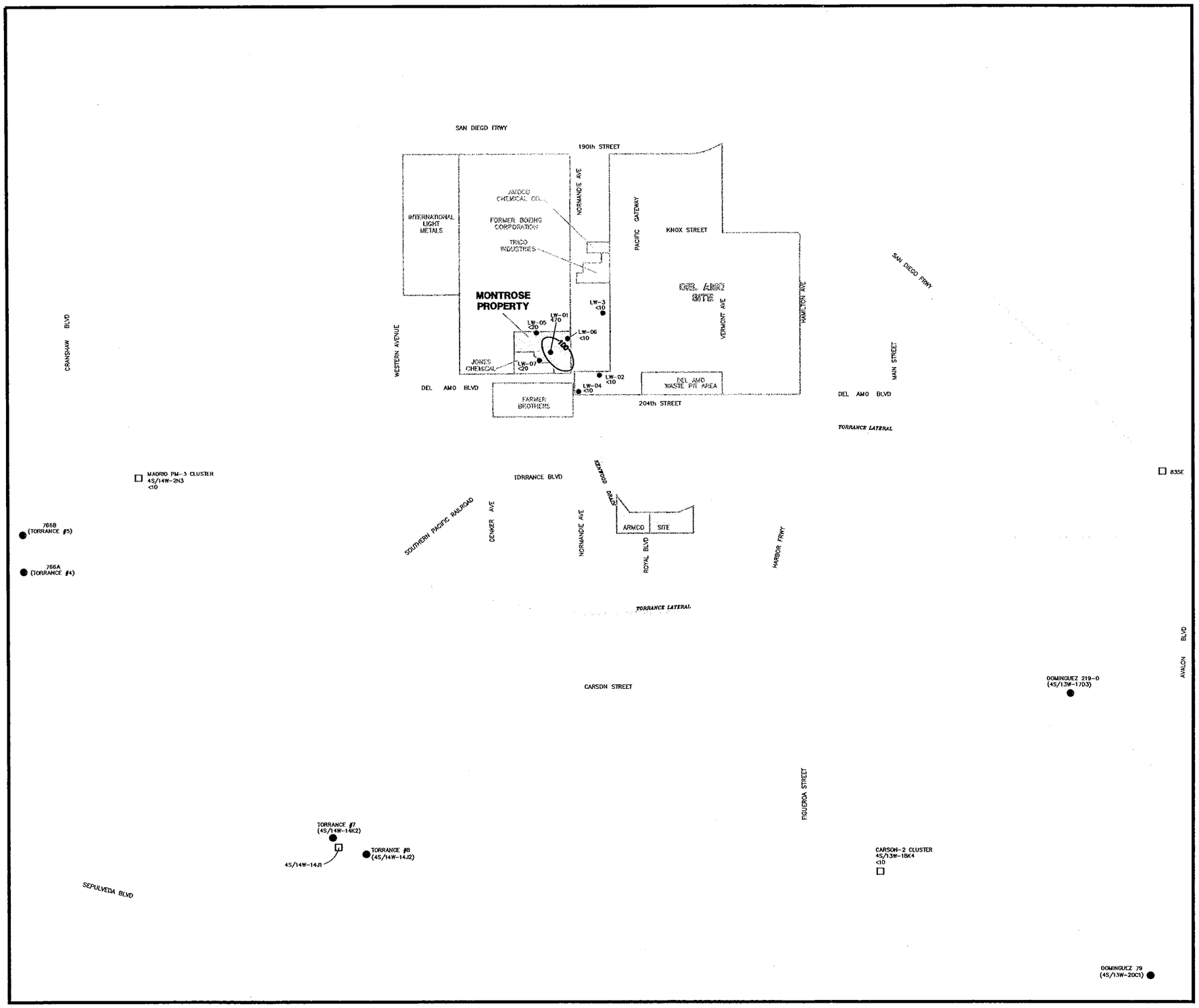
pCBSA GAGE AQUIFER

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

07/04

FIGURE 13

PREP BY GTC REV BY MAP RPT NO. 857.26 | 210-2339 | A



EXPLANATION

LW-01 ● LYNWOOD AQUIFER MONITOR WELL

470 CONCENTRATION IN MICROGRAMS PER LITER

● MUNICIPAL PUBLIC WATER SUPPLY WELL

□ OBSERVATION OR TEST WELL

?———100——— ———?
CONTOUR LINE OF EQUAL CONCENTRATION OF pCBSA IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS CONSTITUENT.

835E WELL NUMBERING SYSTEM USED BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS (LACDPW), FORMERLY LOS ANGELES COUNTY FLOOD CONTROL DISTRICT (LACFCD)

4S/14W-14K2 WELL NUMBERING SYSTEM USED BY THE STATE OF CALIFORNIA, DEPARTMENT OF WATER RESOURCES

NOTE:
WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004.

0 1,800 3,600
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

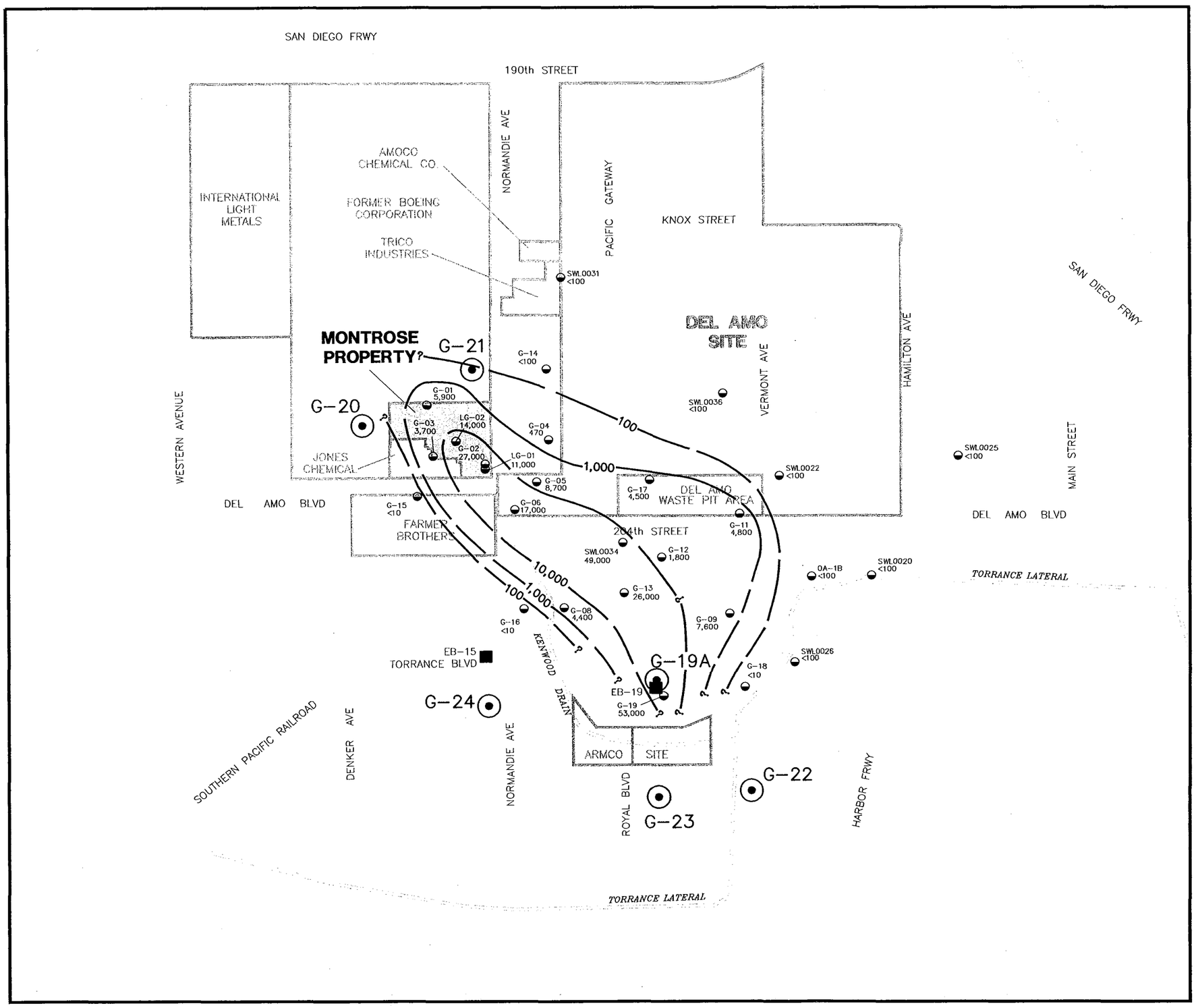
pCBSA
LYNWOOD AQUIFER

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

07/04

FIGURE 14

PREP BY GTC REV BY MAP RPT NO. 857.34 | 210-2341 | A



EXPLANATION

G-09 — GAGE AQUIFER MONITOR WELL

7,600 — CONCENTRATION IN MICROGRAMS PER LITER

PROPOSED GAGE AQUIFER MONITOR WELL

EXPLORATORY BORING LOCATION

?————100———— ————?

CONTOUR LINE OF EQUAL CONCENTRATION OF pCBSA IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS CONSTITUENT.

NOTE:
WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004.
DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

0 1,000 2,000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

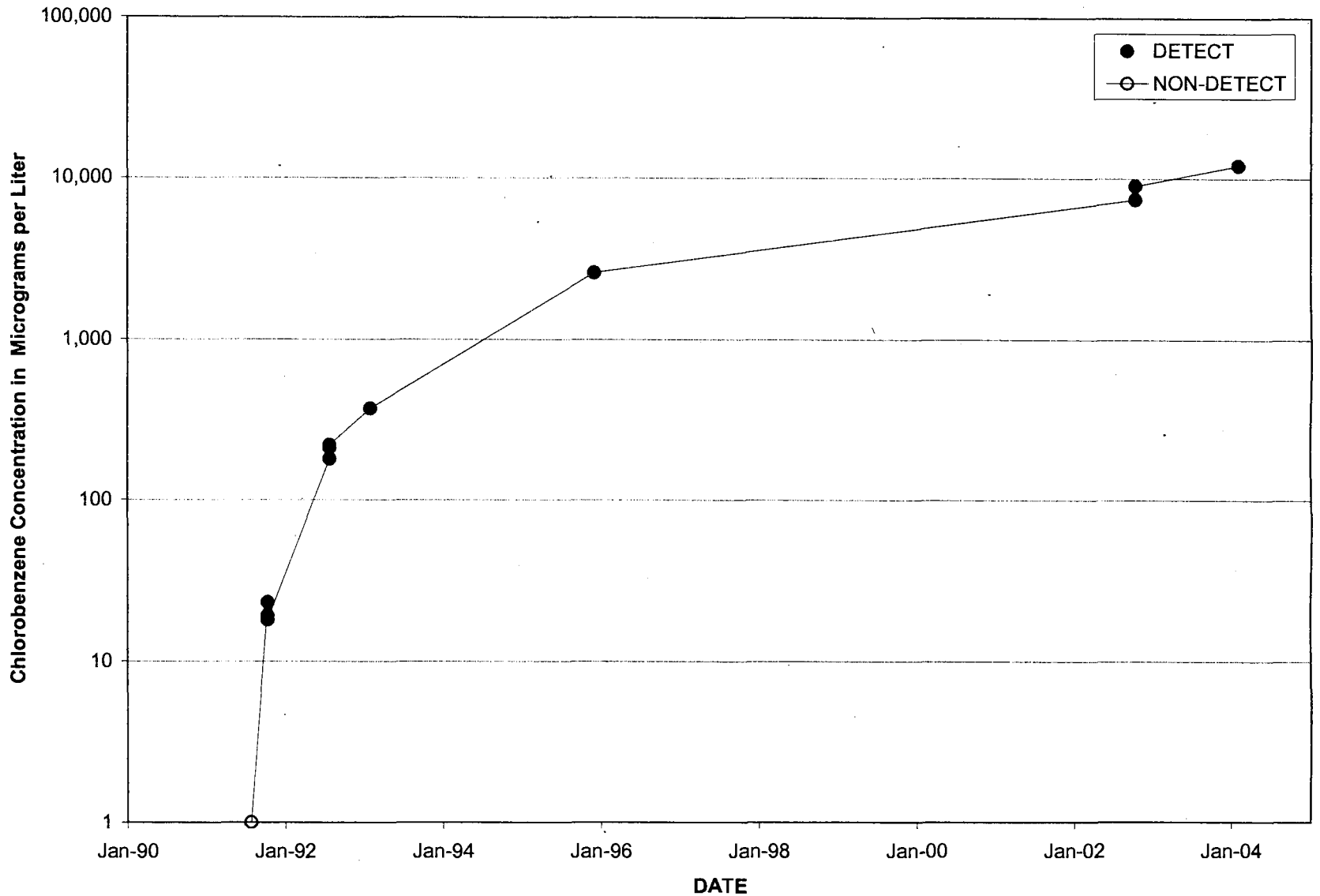
PROPOSED MONITOR WELLS GAGE AQUIFER

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

09/04

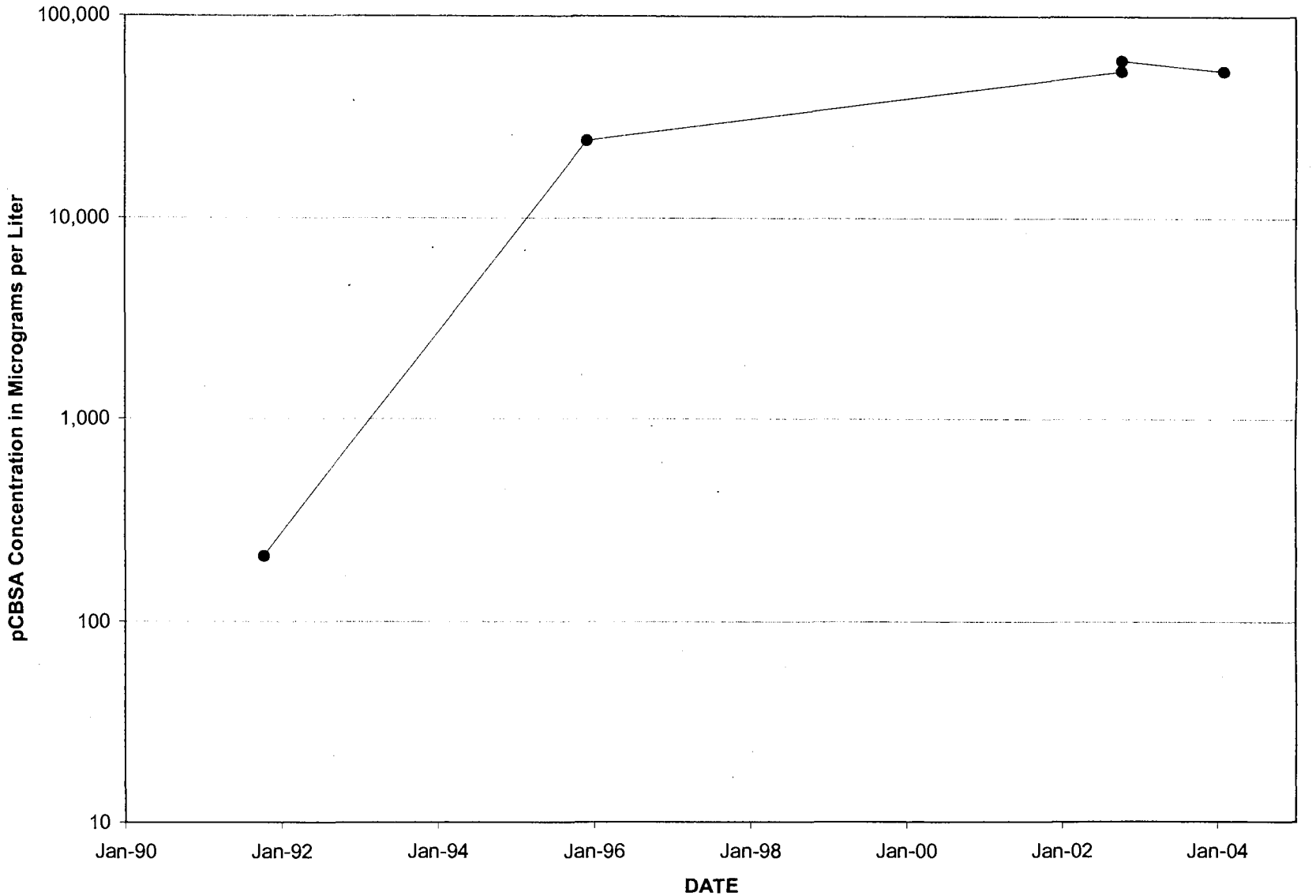
FIGURE 15

PREP BY GTC REV BY MAP RPT NO. 857.34 | 210-2330 | C



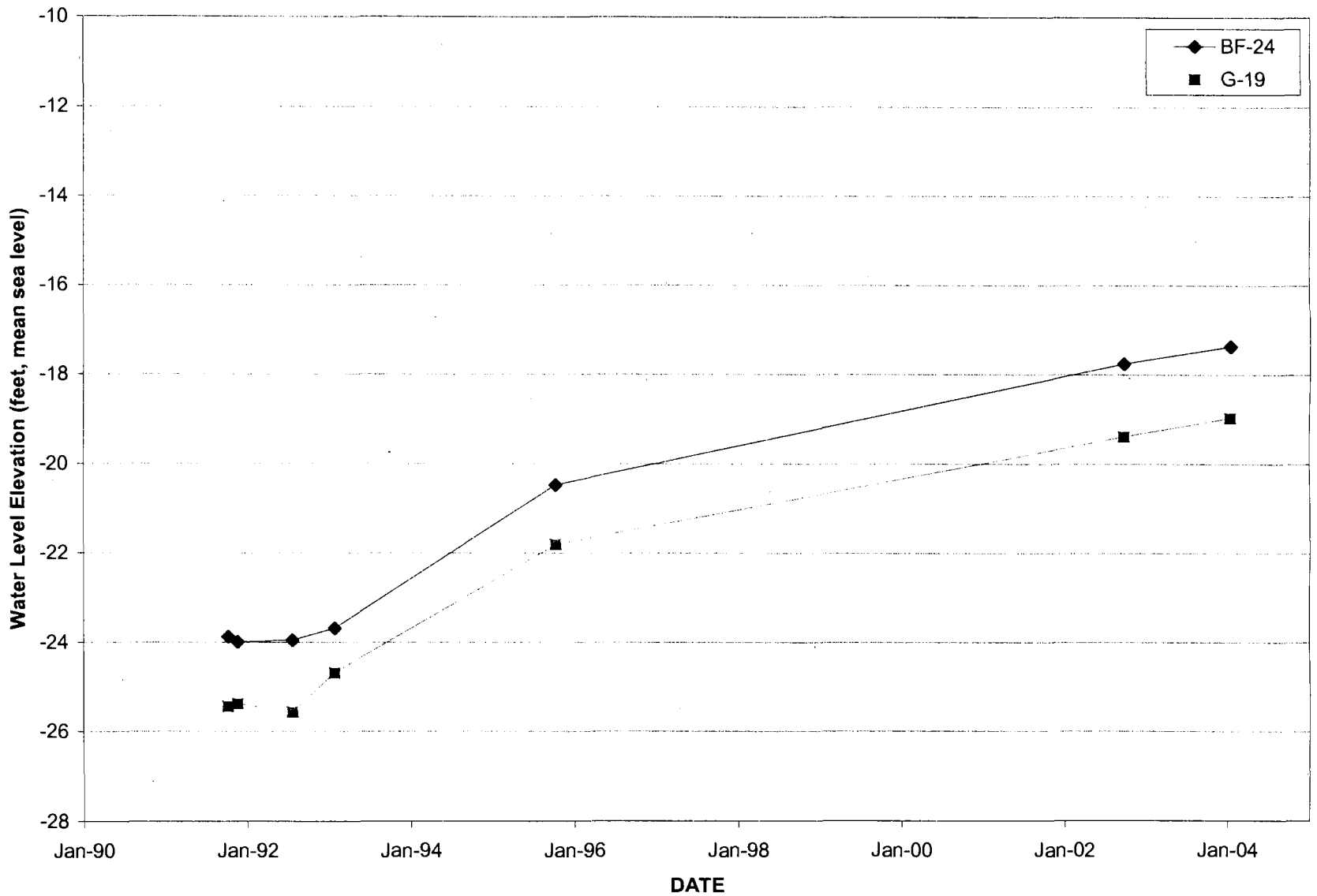
857 Rpt 2004-12 Figs 16-18
07/08/04

FIGURE 16. CHLOROBENZENE IN GROUNDWATER MONITOR WELL G-19



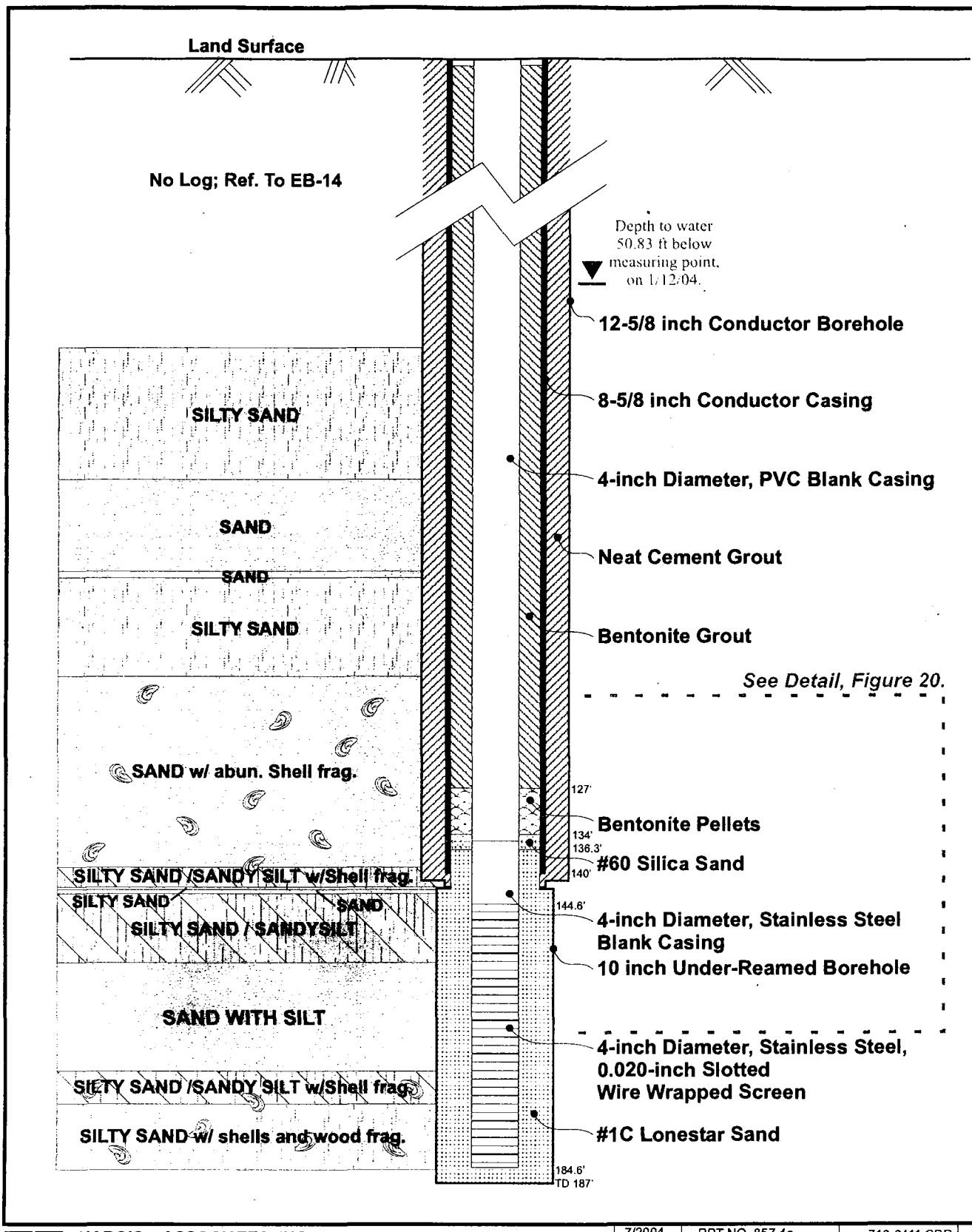
857 Rpt 2004-12 Figs 16-18
07/08/04

FIGURE 17. pCBSA IN GROUNDWATER MONITOR WELL G-19



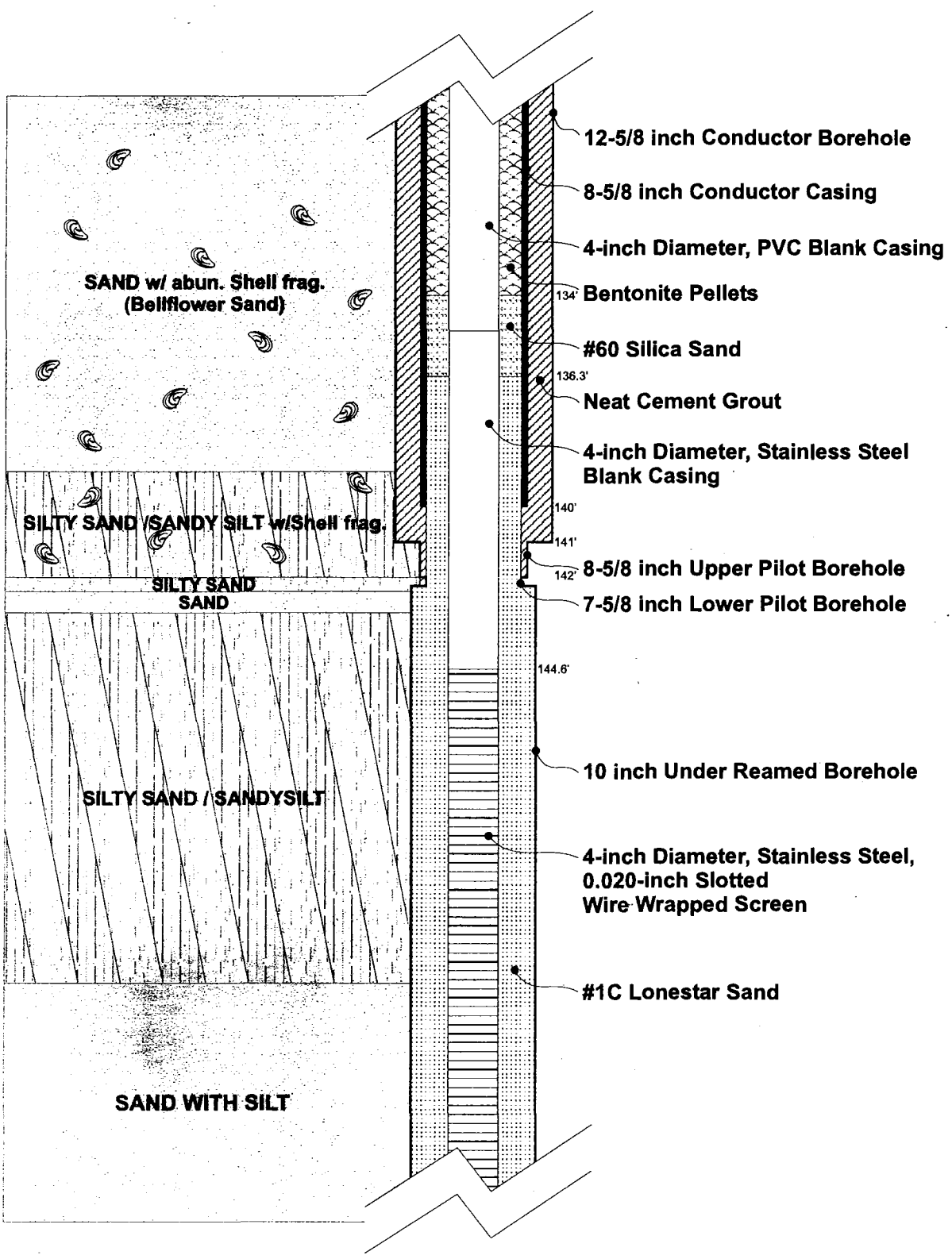
857 Rpt 2004-12 Figs 16-18
07/08/04

FIGURE 18. WATER LEVEL ELEVATION HYDROGRAPH MONITOR WELL BF-24 AND G-19



HARGIS + ASSOCIATES, INC.	7/2004	RPT NO 857.4a	710-0411.CDR

FIGURE 19. WELL CONSTRUCTION DIAGRAM, MONITOR WELL G-19



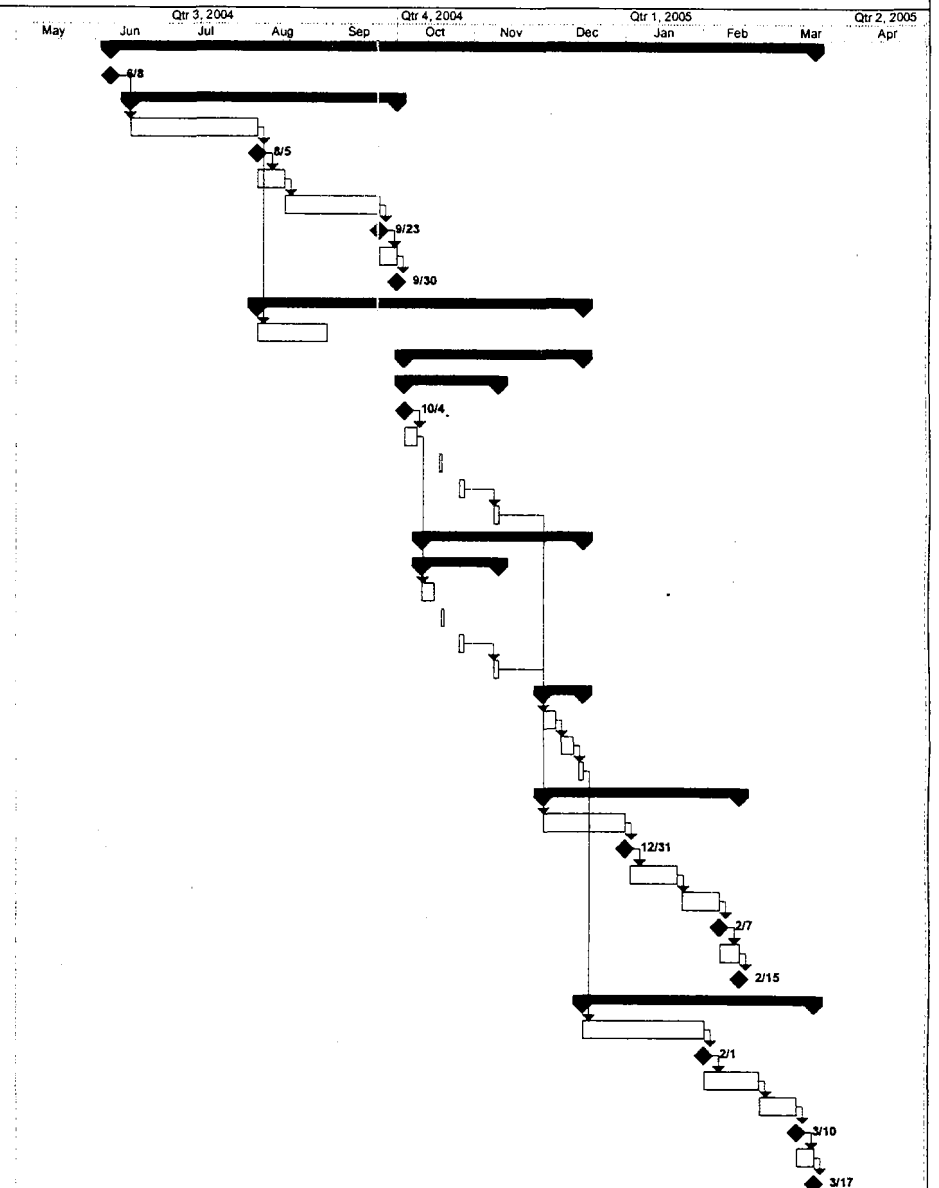
HARGIS + ASSOCIATES, INC.

7/2004	RPT NO 857.4a	710-0412.CDR

FIGURE 20: DETAILED WELL SCHEMATIC, MONITOR WELL G-19

Figure 21
Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Data Acquisition for Model Refinement**	**193 days**	**Tue 6/8/04**	**Thu 3/17/05**	
2	EPA requests additional Wells	0 days	Tue 6/8/04	Tue 6/8/04	
3	**Workplan/FSP/QAPP-DIN 020**	**75 days**	**Wed 6/16/04**	**Thu 9/30/04**	
4	Prepare Plan/Montrose Review	36 days	Wed 6/16/04	Thu 8/5/04	2FS+6 days
5	Submit Draft to EPA	0 days	Thu 8/5/04	Thu 8/5/04	4
6	EPA Review	7 days	Fri 8/6/04	Mon 8/16/04	5
7	Revise Plan	27 days	Tue 8/17/04	Thu 9/23/04	6
8	Submit Final to EPA	0 days	Thu 9/23/04	Thu 9/23/04	7
9	EPA Review	5 days	Fri 9/24/04	Thu 9/30/04	8
10	EPA Approval	0 days	Thu 9/30/04	Thu 9/30/04	9
11	**Install Additional Monitor Wells**	**90 days**	**Fri 8/6/04**	**Tue 12/14/04**	
12	Access and Permitting	20 days	Fri 8/6/04	Thu 9/2/04	4
13	**Fieldwork**	**50 days**	**Mon 10/4/04**	**Tue 12/14/04**	
14	**G-24 Well Construction and Sampling**	**28 days**	**Mon 10/4/04**	**Wed 11/10/04**	
15	Completion of G-22 and G-23-See pCBSA Workplan	0 days	Mon 10/4/04	Mon 10/4/04	
16	Install Monitor Well G-24	5 days	Mon 10/4/04	Fri 10/8/04	15
17	Well Development	1 day	Mon 10/18/04	Mon 10/18/04	
18	Initial Water Levels and Sampling	2 days	Tue 10/26/04	Wed 10/27/04	
19	Second Round Water Levels and Sampling	2 days	Tue 11/9/04	Wed 11/10/04	18FS+8 days
20	**G-19 Destruction/G-19A Construction**	**45 days**	**Mon 10/11/04**	**Tue 12/14/04**	
21	**G-19A Well Construction and Sampling**	**23 days**	**Mon 10/11/04**	**Wed 11/10/04**	
22	Install Monitor Well G-19A	5 days	Mon 10/11/04	Fri 10/15/04	16
23	Well Development	1 day	Tue 10/19/04	Tue 10/19/04	
24	Initial Water Levels and Sampling	2 days	Tue 10/26/04	Wed 10/27/04	
25	Second Round Water Levels and Sampling	2 days	Tue 11/9/04	Wed 11/10/04	24FS+8 days
26	**G-19 Destruction**	**12 days**	**Mon 11/29/04**	**Tue 12/14/04**	
27	Evaluate G-19A Data	5 days	Mon 11/29/04	Fri 12/3/04	25FS+10 days
28	Mobilization	5 days	Mon 12/6/04	Fri 12/10/04	27
29	Destroy G-19A	2 days	Mon 12/13/04	Tue 12/14/04	28
30	**Completion Report DIN 004**	**51 days**	**Mon 11/29/04**	**Tue 2/15/05**	
31	Prepare Report/Montrose Review	20 days	Mon 11/29/04	Fri 12/31/04	19FS+10 days
32	Submit to EPA	0 days	Fri 12/31/04	Fri 12/31/04	31
33	EPA Review	15 days	Mon 1/3/05	Fri 1/21/05	32
34	Revise Report	11 days	Mon 1/24/05	Mon 2/7/05	33
35	Submit Final to EPA	0 days	Mon 2/7/05	Mon 2/7/05	34
36	EPA Review	5 days	Tue 2/8/05	Tue 2/15/05	35
37	EPA Approval	0 days	Tue 2/15/05	Tue 2/15/05	36
38	**Well Abandonment Report DIN 046**	**61 days**	**Wed 12/15/04**	**Thu 3/17/05**	
39	Prepare Report/Montrose Review	30 days	Wed 12/15/04	Tue 2/1/05	29
40	Submit to EPA	0 days	Tue 2/1/05	Tue 2/1/05	39
41	EPA Review	15 days	Wed 2/2/05	Wed 2/23/05	40
42	Revise Report	11 days	Thu 2/24/05	Thu 3/10/05	41
43	Submit Final to EPA	0 days	Thu 3/10/05	Thu 3/10/05	42
44	EPA Review	5 days	Fri 3/11/05	Thu 3/17/05	43
45	EPA Approval	0 days	Thu 3/17/05	Thu 3/17/05	44



Project: 857 Rpts 2004-12 Fig 21 Sche
Date: Thu 9/23/04

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

APPENDIX A

STANDARD OPERATING PROCEDURES FOR LOW FLOW PURGING

APPENDIX A

STANDARD OPERATING PROCEDURES FOR LOW FLOW PURGING

(Adapted from San Diego County Department of Environmental Health Guidance Site Assessment and Mitigation Manual 2004.)

Low-flow Purging and Sampling Method

The low-flow purging and sampling method has been described in the literature since the mid-1980s with a defined methodology being accepted by the U.S. EPA in 1995. An overview of this methodology is presented in a U.S. EPA Ground Water Issue paper titled *"Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures"* by Robert Puls and Michael J. Barcelona dated April 1996.

Low-flow purging and sampling is appropriate for collection of groundwater samples for all groundwater contaminants, including inorganic compounds, metals, pesticides, polychlorinated biphenyls (PCBs), volatile and semi-volatile organic compounds (VOCs and SVOCs), other organic compounds, and radiochemical and microbiological constituents. This method is not applicable to the collection of LNAPL or DNAPL.

Low-flow refers to the velocity of the water entering the pump intake. Low-flow purging also results in limited drawdown. This method can be applied to wells that meet the following criteria:

- The well can be pumped at a constant low-flow rate of 0.1 to 1.0 lpm, with an overall **goal** of less than 0.10 meter or 0.33 foot of drawdown in the well during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities and may require adjustment based upon site-specific conditions. The goal is to minimize drawdown and achieve a stabilized pumping water level as soon as possible.
- The maximum well screen or open borehole intake length should be 20 feet when sampling from a single point within the intake.
- Where the screen or open zone is longer than 20 feet and a target zone cannot be identified based on either of the boring logs, it may be necessary to sample multi-levels to identify the target zone.

a. Pump Placement

Proper pump placement requires detailed knowledge of the site's lithology, the hydrogeologic properties, and the well construction details, along with the specific goals and objectives of the monitoring program. The following is general guidance on pump placement. Following placement of the pump, the well needs to sit for a minimum of 2 hours prior to purging.

(1) Homogeneous Geologic Conditions

For a well screened or open across a single homogeneous geologic unit and where the saturated interval is not more than 20 feet long, the pump intake should be positioned in the mid-point of the screened or open zone. It is assumed under these conditions that water will be drawn from the entire intake area, even under low-flow pumping rates. Where the compounds of interest are known to concentrate near the top or the bottom of the screen zone, it may be desirable to locate the pump intake in the upper one-third or lower one-third of the interval, respectively.

(2) Heterogeneous Geologic Conditions

For a well screened or open across heterogeneous geologic conditions and where the saturated interval has layers of contrasting permeability, it may be necessary to locate the pump intake adjacent to any anticipated preferential flow pathways or zones of concern.

b. Flow Rate

The flow rate used during purging must be low enough to avoid increasing the water turbidity. The following measures should be taken to determine the appropriate flow rate.

- The flow rate should be determined for each well, based on the hydraulic performance of the well.
- The optimum flow rate for each well should be established during well development or redevelopment, or, if possible, in advance of the actual sampling event.
- The flow must be adjusted to obtain stabilization of the water level in the well as quickly as possible.
- The maximum flow rate used should not exceed 1 lpm (0.26 gpm).
- Once established, this rate should be reproduced with each subsequent sampling event.
- If a significant change in initial water level occurs between events, it may be necessary to reestablish the optimum flow rate at each sampling event.

c. Measurement of Water Level and Drawdown

Measurement of the water level in the well during purging is important when establishing the optimum flow rate for purging. The goal is to achieve a stabilized pumping water level as quickly as possible with minimal drawdown, to avoid stressing the formation and mobilizing solids and to obtain stabilized indicator parameters in the shortest time possible.

d. Measurement of Indicator Parameters and Turbidity

Continuous monitoring of water quality indicator parameters is used to determine when purging is completed and sampling should begin. Stabilized values, based on selected criteria listed in Table 5-7 should be met prior to sampling. The use

of an in-line flow cell (closed) system is recommended for measuring indicator parameters, except for turbidity. Indicator parameter collection is more important when low-flow purging is used and additional parameters are needed as compared to the high-flow purging method.

Generally, measurements are taken every 3 to 5 minutes and water chemistry parameters are considered to be stable when they are within the following ranges for three consecutive readings.

TABLE 5-7: STABILITY CRITERIA FOR LOW-FLOW PURGING	
Constituent	**Criteria**
Dissolved Oxygen Content (DO)	± 0.2 mg/l
Oxidation-Reduction Potential (redox)	± 20 mv
Turbidity	± 10 %
Specific Conductance	± 3-5% of reading
Temperature	± 3% of reading (min. of ± 0.2°C)
pH	± 0.2 units

e. Equipment Requirements

Because the methodology requires that disturbance to the water column in the well be minimized, the same pumping device used for purging should be used for sampling (i.e., the pump should be left in place after purging). Refer to Table 5-5 and Table 5-6 for the proper pumping equipment for the low-flow method.

(1) Dedicated and Portable Systems

Studies have shown that installation of any device into a well disturbs the stratification typically exhibited in a well due to laminar flow of groundwater in the well. Insertion also potentially mobilizes suspended solids in the water column due to disturbance of settled and adhered solids in the casing and agitation of water in the filter pack. Therefore, low-flow purging and sampling techniques are more accurate when dedicated systems are used. Dedicated systems result in lower initial turbidity values and lower purge volumes to achieve stabilized indicator parameter readings and should be considered when a well will be sampled multiple times.

If portable systems are used, they must be placed carefully into the well and lowered into the screen zone as slowly as possible. Placement of the portable pump can disturb the groundwater flow conditions resulting in non-equilibrium conditions. Therefore, longer purge times and greater purge volumes may be necessary to achieve indicator parameter stabilization. In general, this may require that, after installation, the portable pump should remain in place at least 2 hours to allow settling of solids and re-establishment of horizontal flow through the screen zone. If initial turbidity readings are excessive (>50 nephelometric turbidity units [NTU]), pumping should cease and the well should rest for another 1 to 2 hours before re-initiating pumping. In wells set in very fine-grained formations, longer waiting periods may be required. If the well consistently produces high turbidity

water (>50 NTU), even at low pumping rates, redevelopment of the well should be considered before further sampling.

(2) Water-Level Measurement Equipment

Continuous water-level measurement devices are preferred, such as down-hole pressure transducers, but electronic water-level tapes can be used. The devices used must be capable of measuring to 0.01-foot accuracy.

(3) Indicator Parameter Equipment

Measurement of indicator parameters (dissolved oxygen content, redox potential, specific conductance, temperature, and pH) is required. This is most easily performed using an in-line flow cell (closed) system attached directly to the pump discharge tubing. For turbidity measurement, a separate field nephelometer should be used.

f. Collect Samples

After the monitoring well has been properly purged using the low-flow method, use the guidelines outlined in Section 5.VII.B.1.h (where appropriate) for groundwater sample collection. However, when using this method it is of utmost importance to collect the groundwater samples using the same pump or device used for low-flow purging without moving it or causing disturbance to the well.